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ALPHABETICAL INDEX TO ARTICLES

	Page.	
Our "Majority" Number: Introductory Article	9	11
Alluvial Diamonds: Origin of (by David Draper)	53	57
Anti-Attrition Bronze		156
Automatic Extraction Process (by Prof. Gaston Jacquier)	337	339
Automatic Transport of Pebbles	341	342
Agriculture in South Africa: A New Era (by H. P. Gordon)	385	389
Agriculture in Transvaal: Influence of Johannesburg (by F. T. Nicholson)	397	400
Automobile World (Illustrated)	403	412
Beginnings of Rand Mining and of the "Mining Journal" (by Col. R. A. Bettington)	13	15
Banking Progress in South Africa	245	248
Cullinan Diamond: Story of (by Dr. Molengraaff)		97
Capital Expenditure of Rand		266
Cyanide Process on the Rand, Illustrated (by William Bettel)	267	274
Coalfields of South Africa (by Rowland Gascoigne)	363	382
Coal Owners (Transvaal), Prospects and Policy of Collieries (Natal Navigation)	382	383
Cotton Growing in Lydenburg (by Lieut.-Col. F. van Steinaecker)	400	401
Diamonds: Earliest Discoveries in Cape Colony and Transvaal (by David Draper)	99	101
Diamond Fields, Early Days on (by Theodore Reunert)	209	213
Diamond Recovery Methods, Development of (Prize Paper, with diagrams, by Dr. Joh E. Barnitzke)	275	277
Diamond Industry of South Africa, with Illustrations and Diagrams (by Harold S. Harger)	56	59
Dividends, Transvaal Gold Mining	328	329
Electrically-driven Air Compressors	163	164
Electricity in Alluvial Tin Working (Prize Essay, by W. A. Moore)	117	119
Engineering Standards (S.A.) Committee (by Professor John Orr)	358	361
Forcing of a Process (by Alfred James)	37	43
Free Trade and Protection in South Africa (by Samuel Evans)	109	111
Features of Mining in South Africa (by J. Allan Woodburn)	199	201
Future of the Rand (by Gustave Imroth)		207
Farming in South Africa (by W. T. Seccombe)	391	393
Gold Production, Witwatersrand		234
German S.W. Africa: Mining and Ore Treatment	323	324
Geology of Witwatersrand	343	346
Hints for Hand Stopers (Prize Paper, by John V. Miller)	203	205
Health and Living Conditions on Rand Mines	330	331
Hydraulic Classification (by G. A. Robertson)	334	336
Induction Motor, New Type, with Illustrations and Diagrams (by M. I. Williams-Ellis)	235	243
Invention, South African	348	349
Johannesburg—Past and Present (by W. Smale Adams)	261	263
Katanga Copper Fields	306	307
Large Machines, Defence of (by F. P. Ward)	63	65
Loose Nut Problem		156
Life Insurance: General Review	223	227
Life Assurance: South Africa v. Oversea Offices	232	233
Lonely Reef, Rhodesia	313	314
Land Companies		466
Mining Men and the "South African Journal"	29	32
Metallurgical Bookkeeping (by Sidney J. Jennings)		33
Metallurgy, Evolution in (by H. A. White)	59	61
Mining Economics, New Aspect of (by William Cullen)	114	115
Manufacturing Devlopments in Engineering World		121
Mineral Exploration in Transvaal (by Oliver King)	325	327
Mozambique Territory, Mining in (by Austin King)	133	136
Mining Engineers, Position and Prospects of Young (by Percy Cazalet)	139	143
Miners' Phthisis Sanatorium		157
Metallurgy of Rand Banket (Illustrated)	177	196
Messina (Transvaal) Development Company (By J. M. Calderwood)	218	220
Machine Tools and Modern Methods		250
Mining Industry, What South Africa Owes to it (by Sir David Harris)		35
Metallurgical Prize Papers (by Leslie Stuart Muir)	333	334
Mining Groups	413	465
Native Labour Problem on Rand		168
Notable Cape Commercial House		263
Ore Valuation (by G. A. Denny)	45	51
Ore Handling, New Metbod in Incline Shafts of Flat Dip, with Illustrative Diagrams (by E. J. Way)	145	153
Ore Reserves of the Rand	215	217
Problem of Gold at Depth (by Hugh F. Marriott)	67	69
Pneumatic Tool Progress		250
Phillips, Sir Lionel: Early Interview	93	95
Pilgrim's Rest and Sabie Goldfields (by Arthur W. H. Frost)	315	318
Rand, Tbe: Sixteen Years Ago and To-day (by the late John Stuart)	89	91
Resident Mecbanical and Electrical Engineers on Mines (by Kenneth Austin)	123	125
Reminiscences of the Rand in the 'Nineties (by R. G. Fricker)		208
Rising South African Industries		265
Rhodesia (Southern): Review of Mining and Metallurgy, with Maps and Illustrations	291	302
Rhodesia, Mining in Nortbern (Maps and Illustrations)	303	305
Rhodesian Small-worker (by R. W. Pringle)	309	311
Safety Catches for Mine Cages (by J. A. Vaughan)	283	289
Steel Manufacture in South Africa (by G. Helford Smith)	279	281
Southern Life Association	229	231
Suction Gas Engine Power Station, Largest in South Africa	159	161
State Miners' Training School		157
Siskol Drill in South Africa		165
Swaziland Mining (by Allister M. Miller)	130	132
Stock Exchange, Story of Johannesburg (by Col. R. A. Bettington)	71	87
"South African Mining Journal": Its History	17	19
Sandstone Reef	318	319
Smelting Works, Witwatersrand Co-operative		332
School of Mines and Technology (S.A.), Illustrated (by Prof. G. H. Stanley)	351	457
South African Mines, What they Buy	346	347
Stock Farming in a Transvaal District	394	395
Tin Deposits of Transvaal, with Diagrams and Illustrations	169	175
Ventilation of Rand Mines	127	129
Victoria Falls and Transvaal Power: Review of Position		168
Working Costs on the Rand (by Professor J. G. Lawn)	103	107
Wages Bill of Mining Industry		249
Zambesia Mining		312
Zaaiplaats Tin Mines, with Diagrams and Illustrations (by George H. Furber)	320	322

627726

LIST OF ILLUSTRATIONS

LEADERS OF SOUTH AFRICAN MINING INDUSTRY

Page.

Hon. A. Malan (the Minister of Mines), Mr. M. G. Elkan (the President of the Chamber of Mines), Sir Lionel Phillips, Bart., Mr. R. N. Kotze, Mr. R. W. Schumacher, Sir George Farrar, Mr. A. Brakhan ... ... Supplement.

Sir George Alhu, Bart., Mr. W. L. Honnold, Mr. John Munro, Prof. Lawn 10

Mr. Samuel Evans, Sir J. W. S. Langerman, Senator Samuel Marks, Sir Percy Fitzpatrick 12

Mr. F. D. P. Chaplin, Mr. W. H. Dawe, Mr. E. A. Wallers, Mr. H. C. Boyd 14

Mr. George Nathan, Mr. Arthur French, Sir Thos. Cullinan, Mr. B. Madew 16

Sir Donald Macaulay, M.L.A., Mr. Ruel C. Warriner, Sir David Harris, M.L.A., Mr. Samuel Thomson 18

Mr. E. J. Way, Mr. H. C. Behr, Mr. H. S. Harger, Mr. Percy Cazalet 20

Mr. G. E. Wehher (late Consulting Engineer, Eastern Group) 164

Col. Dalrymple 465

Sir J. B. Robinson 460

Sir Abe Bailey 449

PUBLIC MEN CONNECTED WITH THE INDUSTRY.

Mr. J. A. Yule, Mr. D. C. Greig, Mr. Fred Rowland, Mr. W. F. Harvey 22

Mr. H. J. Hofmeyr, Mr. C. B. Saner, Mr. C. A. Ferguson, Mr. J. H. Rider 24

Professor Thompson (Principal S.A. School of Mines) 259

Professor John Orr 232

MISCELLANEOUS.

Alluvial Gold Working in the Transvaal:—

Tail Race of Metlepitsi Syndicate... 93

Metlepitsi Water Flume and Alluvial Area ... 107

Alluvial Gold Workings in Transvaal 67

Address to H.R.H. the Duke of Connaught from Rand Technical Societies 87

Air Compressor Valves (Rohey Patent) 163

Automatic Transport of Pehhles, Bliechert's Plant 340-341

Agricultural Society's Show (Witwatersrand) ... 398

Borehole, New Rand Site, Vaal River 95

Burnham Syndicate 316

Coal Mining:—

Withank Colliery 28

Withank Colliery: A Day's Output 221

Cassel Colliery: Early Plants 349

Coal Fields of South Africa: Views of Various Collieries 364-384

Daimler Road Train 412

Electri Power Supply on Rand: Municipal Power Station Interior 119

Early Days in Mining Districts, Barherton, Pilgrims' Rest 378

Farm View in Transvaal 388

Geology of Rand: Composite Section, Lower Witwatersrand Series on Central Rand ... 84

Geology of the Transvaal:—

Reef Horizons, Lydenburg, and Section Lower Witwatersrand, Witpoortje 197

Geological Map of Southern Transvaal 205

General Mining Buildings 19

Historic Rand Functions:—

Sir Geo. Alhu and the King's Medal Hero ... 83

Duke of Connaught Laying Foundation Stone of Johanneshurg Town Hall 88

Half-way House on Pretoria Road, 1892 322

Malaria Fighting: Mosquito Cage, Onderstepoort 81-399

Miners' Phthisis Sanatorium, Front View ... 157

Mali Dyke, Graskop 317

Miners' Training School, Wolhuter 307

Old Johanneshurg Post Office, 1887 357

Power Supply:—

V.F.T.P. Co. 69-70

Views of V.F.T.P. Station, Vereeniging 92-100

Rosherville Station 97

Boiler House under Construction, Rosherville 153

Petrol Loco. Trial, Crown Mines 136

Pilgrims' Rest: Early Views 325-327

Roheson-Bettington Boiler 348-349

Steam Cranes at Wharves, Lourenco Marques ... 362

Showground, Johannesburg 387-392

Scientific Societies:—

S.A. Institute of Engineers at Randfontein ... 51

Chemical, Metallurgical and Mining 91

S.A. School of Mines: Views of Plant, etc. 350-356

Salishury House (where London Offices of "S.A. Mining Journal" are situated) 90

Suction Gas Engine, Rooiherg Tin Mines ... 159

Southern Life Offices, Capetown 229

Schumacher's House Ownership Scheme, View of Area 331

Page.

Transport Difficulties in Early Days 213

Ventilation: Old and New Systems 127

DIAMOND MINING.

Alluvial Diamond Diggings: Views of Mooifontein and London 64

Barkley West River Diggings 211

Diamond Prospect Opening 55

Diamond Prospect, Griqualand East 57

Diamond Washing Plant (Schiechel) 277

Dutoitspan Mine, 1874 212

German South-West:—

View of Spencer Bay 281

Diamond Mining in 255

Work on the Fields 258

Gravel Sorting, Vaal River 210

Kimherley Mine: Deepest Open Mine in the World 252

Kimberley Camp, 1872 210

Kimherley's First Whim, 1874 211

Premier Mine:—

Bird's-eye View 251

Largest Open Mine in the World 253

A Working Face 256

Pniel Estate: Opening up Diamond Paddock ... 254

Vaal River Pont 213

Windsorton Pont, Vaal River 210

TIN AND COPPER MINING.

Cassiterite Find: Ore from Anglo-German Tins Property 286

Geology of Tin Fields: Diagramatic Section across Zaaiplaats Mine 233

Groenfontein Tin Mine Equipment:— 102

Tin Hydraulicing 117

Producer Plant 175

Malgo Copper Mine 235

McCreedy Tin:—

Hydraulic Plant 132

Sluice Boxes at Elevator 132

Messina, Northern Transvaal:— 218

Main Shaft 218

Concentrator 219

No. 3 Shaft 219

Headgear, under Construction 220

Poort Road 220

Swazi Tin:—

Bird's-eye View 130

First Consignment Ready for Transport ... 132

S.A. Tin Company's Mill at Doornhoek 272

Zaaiplaats Tin Mine:—

The Mill 234

Power Housc under Construction 287

Mill and Dressing Plant, with Part of Camp 320

Diagram of Claims, Showing Pipes 321

Views of Workings 321

RHODESIAN MINING.

Broken Hill, Mineralised Kopje 304

Cam Mine, Eiffel Flats 301

Eiffel Flats Shaft 302

Globe and Phoenix: Rhodesia's Leading Mine 294

Gatooma in Early Days 290

Giant Mines 220

Jumho Mine, Mazoe 298

Lonely Mine: Headgear and Reduction Plant ... 313

Motor Mine: Old Mill 296

Motor Mine: Second Mill 297

Penhalonga Mine 300

Prospector's Camp 273

Queen's Mine, Matabeleland 290-299

Rhodesian View (Typical) 290

Rhodesian Small Mines 308-314

Wanderers' Mine, Selukwe 314

Wolfshall Mine, Selukwe 295

OUTSIDE DISTRICTS.

Antimony Reef, Murchison Range 125

French Bob's 98

Forbe's Main Reef, Swaziland, Reduction Plant 131

Pigg's Peak 134

RAND MINING IN PICTURE.

Angelo Shaft, E.R.P.M. 71

Anglo-French Group 82

Apex Pit Headgear and Screening Plant ... 113

Arhuckle Cones 276

Benoni Consolidated, No. 3 Shaft 61

Page.

Benoni Consolidated New Mill 101

Bleichert Sands Discharge, Brakpan 105

Brakpan Mines, Sizing Trommels and Sorting Belts 143

Benoni Mine: Sizing Trommels, Sorting Belts, etc. 179

Brakpan Mines: Diagram of Arrangement of Reduction Plant 182

Bantjes Consolidated: Views at 161-265

Brakpan Mines: Plate House, Launders, etc. ... 189

Benoni Con.: Battery Floor 193

Brakpan Mines: General View 196

Brakpan Mines: Vacuum Filter Plant 194

Cason Mine: Sirocco Fan 129

Con. Langlaagte: Open-fronted Type of Mortar-Box 85

Cyanide Plant (Typical) 289

Crown Mines: Shaft, with Mechanical Haulage 339

Crown Mines Views 68

Central Mining and Investment Group:— 72-79

Turf Mines Shaft, Village Deep 43

Con. Investment Mines: Views on 62

Con. Mines Selection 42-44

City Deep: Views on 96

Crown Reef Mill, Crown Mines 103

Crown Mines New Mill 107

Conveyors, Consolidated Langlaagte 121

Classifiers, Princess Estate 135

Circular Shafts on Rand: Sections at New Primrose and Langlaagte Royal 141

City Deep: Cam Shaft and Ore Bins 186

Conveyor Belts, Crown Mines 191

Classifiers (Caldecott Cone), Simmer and Jack 192

Crown Mines: Tuhe Mill Pehhle Bin and Tube Mills 201

City Deep: Extractor Boxes 195

Comet Mine 230

Con. Gold Fields Offices 274

Crown Mines: Trestle-way 33

Crown Mines: South Rand Shaft 217

Decortering Cones, Simmer and Jack 191

E. R. P. Mines 46

Electric Hoists at City Deep and Turf Mines ... 66

Electric Fan at Village Deep 129

Excavator 243

Eagle's Nest Mine, 1889 345

Far East Rand: Diagram of Leading Properties and Rand Klip Neighhourhood 137

Ferreira Mine: Opening up 344

Ferreira's Camp, 1887 343

General Mining and Finance 48-60

Goerz Group 86

Johanneshurg Con. Investment Group 34-38

Johanneshurg Con. Investment Group 94

Modder B Shaft and Sorting House 181

Modern Type of Long Stamp Head, etc., Brakpan Mines 184

Main Reef Workings, Showing Banket Formation 305

Neumann Group 40

New Modderfontein Circular Shaft 45

New Modderfontein Mill under Construction 115

New Kleinfontein: General View 183

New Goch: Tailings Wheel 188

Princess Estate 165

Roodepoort U.M.R. G.M. Co. 32

Rohinson Deep G.M. Co. 26

Robinson G.M. Co.: West Shaft 99

Randfontein Central: Tube Mill House 187

Rohinson Deep: Tuhe Mill, Feeder, etc. ... 188

Rohinson Group 106-110

Sinmer Deep 11

Stope Drills: Historic Tests at the Rohinson ... 15

Smelting Works (Co-operative) on Rohinson Mine 79

Sand-Collecting and Slimes Treatment Vats, Roodepoort United 190

Sand-Collecting Vats, Nourse Mines 203

South Rand Headgear, Crown Mines 342

Sands Plant, Simmer and Jack 288

Slimes: Settlement with Lime 268

Slimes: Bird's-eye View of Bettel's Treatment ... 270

Slimes Plant: Bettel's Experimental 269

Smelting Room at Crown Mines 336

Turf Mines Shaft, Village Deep 319

Tuhe Mill Plant 271

Underground Views: Witwatersrand and Jupiter 112

Village Deep 65

View on Reef (Typical) 132

West Rand Consolidated: Shaft and Ore Bins under Construction 177

West Rand Consolidated: Heavy Stamp Battery, etc. 193

West Rand Unified Mill 111

SA
V.102 sup

INDEX TO ADVERTISERS

(See Classified Index)

	Page.
A.E.G. Electrical Company of S.A., Ltd.	116
African Banking Corporation, Ltd.	246
African World, Ltd.	432
Andrew and Thienhaus, Ltd.	200
Angus and Co., Ltd.	140 176
Anti-Attrition Metal Co., Ltd., The	3
Atlas Assurance Co., Ltd., of London	226
Barder and Co., H.	128
Bartle and Co., Ltd.	148
Batten and Edgar	152
Beckett and Co., Ltd., T. W.	264
Bellamy and Lambie	142
Blackman Export Co., Ltd.	162
Bleichert and Co., Ad.	214
Bull and Oehmen, Ltd.	176
Bullen Bros.	227
Burmester, E.	4
Campbell, O'Brien and Co.	6
Chevers, Jesse C.	4
Chudleigh Bros., Ltd.	264
Consolidated Pneumatic Tool Co., Ltd., The	284
Continental Tyre and Rubber Co. (S.A.)	402
Cradock and Co., Ltd., Geo.	158
Currie, Richard	262
Cyclone Gate and Fence Co., Ltd.	386
Davies and Co., Hubert (3rd cover)	204
Demag, Ltd.	128
Denver Rock Drill and Machinery Co., Ltd.	198
Dick, Kerr and Co., Ltd.	152
Drury and Co., D.	144
Duval Tyre Co. (S.A.)	410
Flottmann Engineering Co. (of S.A.), The	282
Fraser and Chalmers, Ltd. (4th cover).	
Gill and Co., H.	406
Glover Bros.	158
Harvey and Co., Ltd.	140 176
Head, Wrightson and Co. (S.A.), Ltd.	178
Hera Light, Ltd., The	4
Herrman and Davis, Aug.	262
Hilger, Ltd., Adam	249
Hoppert, F.	7 409
Ingersoll-Rand Co. (1st cover)	166 167
James Motor Cycles	6
Johannedals Timber Co., Ltd.	376
Johnstone, W. F.	376
Kitson (Cape) Lighting Co., The	131
Liddle, Joseph	226
London and Lancashire Fire Insurance Co., The	227
Magnolia Anti-Friction Metal Co., Ltd., of Great Britain, The	164
Meikle and Co., Ltd., Arthur	262
Mosenthal Bros., Ltd.	260
Mosenthal and Co., Ltd., Adolph	390
Mosenthal and Co.	396
Natal Navigation Collieries and Estate Co., Ltd.	376
National Bank of South Africa, Ltd.	248
Netherlands Bank of South Africa	246
New Transvaal Chemical Co.	6
Parson's Non-Skid Co., Ltd., The	408
Power and Greatrex 154 156 160	
Raffael and Co., B.	3
Reunert and Lenz (2nd cover).	
Rintoul and Davies	146
Robey and Co. (S.A.), Ltd.	8
Sandycroft Foundry Co., Ltd., The	120
Siemens, Ltd.	126
Small Mines Supply and Engineer Co. 1 124 180 206 278	
South African General Electric Co.	122
South African Mutual Life Assurance Society, The	224
Southern Life Association	228
Standard Bank of South Africa, Ltd.	244
Standard Life Assurance Co.	222
Star Assurance Society	227
Sturrock and Co.	2
Sun Fire Office	231
Sykes and Co., Ltd., S.	118
Tarry and Co., Ltd., E. W.	150
Texas Co. (S.A.), Ltd., The	404
Union-Castle Mail Steamship Co., Ltd.	380
United Engineering Co., Ltd.	280
Wade and Dorman, Ltd.	5
Ward and Mortleman 158 202	
White and Poppe, Ltd.	7
Wienand, C. F.	138
Wolf, R.	7
Wright, Boag and Co.	150

BUYERS' DIRECTORY—Classified Index of Advertisers' Announcements

See Alphabetical Index to Advertisers)

A.

	Page.
Acid, Sulphuric	6
Agitators	178
Agricultural Machinery	390
Anti-friction Metal (2nd cover) 3	164
Arc Lamps (3rd cover)	146
Artificial Limba	176
Auctioneers, Appraisers, and Live Stock Salesmen	262
Automobiles	116
Axles (3rd cover).	

B.

Ball Mills	278
Banks 244 246	248
Bars, Furnace	144
Bars, Tube Mill Liner	138
Battery, Screening	138
Battery Spares 120	280
Bells and Pulls, Mine	146
Belts, Laminated	142
Belting 1 140 142	144
Bins, Ore	1
Blocks, Vee	144
Block and Tackle	140
Blowers	144
Boilers (3rd cover) 8 120	140
Boiler Compound	146
Boiler Coverings, Asbestos (2nd cover).	
Boiler Tubes	200
Bolts	138
Boring Tools	144
Boring Tubes	200
Brickmaking Machinery	280
Bridges	278
Broaching Machines	144
Buildings, Wood and Iron	376
Bungalows, Steel	4
Bye-Products Plant	280

C.

Cables 116	126
Cable, High and Low Tension	409
Cages	1
Candles, Mining and Household	6
Calculating Machines	249
Capels, Rope	142
Carbide	4
Carbon Brushes (3rd cover).	
Cars	152
Castings, Steel (4th cover).	
Cement	376
Cement Machinery	280
Chains, Motor Tyre	408
Channels, Angles, Tees, etc. 5	280
Chimneys	152
Chipping Hammers	167
Chucks	144
Cleaning Installations, Vacuum	284
Coal Cutters 167	206
Coating, Non-Corrosive	146
Cold Storage Plants	280
Collieries	376
Compressors, Air 8 124 128 140 166 280 282 (2nd and 3rd cover).	284
Concentrating Machinery	1
Condensing Plant (2nd and 3rd cover).	
Cones	152
Constructional Work	1
Controllers 120	152
Conveying Machinery	214
Cooking Apparatus, Electric (3rd cover)	116
Couplings, Shaft	144
Cranes (3rd cover) 1 28 204	278
Cream Separators	390
Crushing Machinery (2nd cover) 1 8	120
Cyanide Buckets, Dishes and Pans	176
Cyanide Tanks	152

D.

Damper Regulators	144
Dies	144
Disinfectants	6
Drapery	264
Dressings, Belt 144	146
Dressings, Gear 144	146
Dressings, Wire Rope 144	146
Drilling Machines	144
Drills, Breast	144
Drills, Core	166
Drills, Electric	284
Drills, Hammer 166 198 202	282
Drills, Pneumatic Corner	284
Drills, Radial	148
Drills, Rock (1st and 4th cover) 120 166	282
Drills, Rotary	157
Drills, Twist 144	200
Drills, Vertical	148
Drill Sharpeners	202
Driving Chains and Wheels (3rd cover).	
Dumping Bridges, Waste Heap	214
Dynamos	126

E.

Electric Instruments (3rd cover)	126
Electric Light Fittings (3rd cover)	126
Electrical Machinery and Supplies 1 116 120 126 128	122
Elevators, Electric 1	124
Elevating Machinery	214
Emery Wheels	144
Emery Wheel Dressers	144
Enamelware, Mine	176
Engineering Requisites (2nd cover)	142
Engineering Works	150
Engines Gas (3rd and 4th cover) 2	144
Engines, High Speed	140
Engines, Motor Car	7
Engines, Oil, and Petrol (3rd cover) 1 8 140 144	280
Engines, Quick Revolution (2nd cover).	
Engines, Steam (2nd cover) 8	
Engines, Winding 8	128
Estate Agents	262
Explosives 390	396
Fans, Ventilating (2nd cover) 116	162
Feathers, Ostrich	390
Feeders, Ore	1
Fencing Material 386	396
Financial Institutions 244 246	248
Fire Appliances	140
Forges, Rivetters	162
Forgings (3rd cover).	
Foundries 124	128
Fuses, Safety	200

G.

Galvanised Iron 376	396
Gas Plants (3rd cover) 140	280
Gates 1	386
Gates, Cut 142	150
Gears, Haulage 1 8 120	124
Gears, Raw Hide 140	150
Gears, Speed Reducing	140
Gears, Winding	1
General Merchants 260 390	396
Generators (3rd cover) 120 204	206
Glands, Rope	142
Grain Milling Machinery	140
Greases, Antifriction 6	404
Greases, Rope 6	404
Grinding Machinery 120 144	284
Guide Rods	158

H.

Hacksaws, Power	144
Hardware 390	396
Hammers, Mining	138
Headgears 1	278
Heating Apparatus, Electric (3rd cover)	116
Heating Installations	280
Hides, Skins and Horns 390	396
Hoists, Electric	280
Hoists, Steam (4th cover)	120
Hose 140 142	176

I.

Instruments	280
Insulators	116
Insurance 222 224 226 227 228	231
Iron, Angle and Bar (3rd cover)	138
Iron Works	124
Irrigation Plant	200

J.

Jacks (3rd cover)	
Jewellery 4	116
Joists, Steel 5	280

K.

Keyseating Machines	144

L.

Lamps, Aceylene (2nd cover)	4
Lamps, Arc (3rd cover)	146
Lamps, Electric (3rd cover) 116 122	126 146
Lamps, Miners	4
Lamps, Oil	131
Labour Saving Appliances	284
Lathe Dogs	144
Lathes, High Speed 144	148
Lathes, Power and Treadle	144
Lathes, Quick Change	144
Leather Goods	140
Lifting Gear (3rd cover).	
Lightning Arresters	146
Liners, Pump	150
Liners, Tube Mill	150
Lockers, Change House	144
Locomobiles, Steam 7	280
Locomotives, Electric 1 116 152	206
Locomotives, Petrol 1	124

M.

Page.

Machine Tools 140 148
Magnetos 409
Mains, Air and Water 200
Maize Exporters 396
Manhole Joints 144
Manila Rope 144
Manures, Artificial 6
Measuring Instruments 116
Mechanical Machinery 120
Merchants, Wholesale 340
Metal, Asbestos Protected 146
Metal, Bearing 144
Meters 146
Meters, Electric 116
Milling Attachments 144
Milling Cutters 144
Milling Machines 144 148
Mills, Rotary 1 180
Mine Fittings 146
Mining Equipment (1st, 2nd and 4th covers) 1 124 142 206 278
Mining Supplies (1st, 2nd and 4th covers) 144 148 150 154 176 260 278
Motor Cars and Accessories 406
Motor Cycles and Accessories 6
Motor Control Gear ... ... (3rd cover).
Motor Garages 406
Motor Repair Kit 408
Motors, Shaking Chute 282
Motor Starters ... ... (3rd cover).
Motor Spirit 404
Motor Tyres 402
Motor Tyre Protectors 410
Motors, Electric 1 120 122 146 152 176

N.

Naphthas 404
Native Truck 396
Newspapers 432
Non-skid Chains for Motor Tyres 408
Nuts 138 155

O.

Oils, Lubricating 404
Oils, Motor 404
Oils, Refined 404
Ore Milling Machinery 180
Outfitting, Ladies' and Gentlemen's 264 390 396

P.

Packings, Metallic 144
Paints 144
Paraffins 404
Parallel Reamers 144
Pelton Wheels ... ... (3rd cover).
Petrol 404
Petroleum Products 404
Picks ... ... (2nd cover).
Pipe Covering, Asbestos ... ... (2nd cover).
Piping and Fittings 200
Planers, High Speed 148
Plate Work, Mining 152
Plates, Amalgamating 1
Plates, Face 144
Plates, Shaft 1
Plates, Steel 5 280

Page.

Plates, Surface 144
Ploughs 390
Pneumatic Tools 167
Poles, Transmission 1 278
Poles, Tramway and Lighting 200
Portable Plants 284
Power Plants, Electric (1st and 2nd covers) ... 205
Power Plants, Steam 1
Power Plant, Suction Gas 1 2
Power Plant, Water ... ... (3rd cover).
Power Transmitting Machinery (2nd cover) 140
Produce Merchants 390 396
Protective Compositions 146
Provisions 390
Publishers 432
Pulp Samplers 146
Pump Columns 200
Pumping Machinery 1 118 120
Pumps, Boiler Feed 118 120 144 280
Pumps, Centrifugal (2nd and 3rd covers) 1 2 118 120 140 176 280
Pumps, Plunger ... ... (2nd cover) 1 120 280
Pumps, Power 118 120 140 146 280
Pumps, Sand and Slimes 150 280
Pumps, Steam 118 120 140 280
Pumps, Sinking 1 120 167 280
Pumps, Turbine 118 120 140 280
Punching Machines 144 148

R.

Rails ... ... (3rd cover) 1 152 200
Railway Material 152 200
Railway Stations 278
Refrigerating Plant 280
Refrigerator Coils 200
Rescue Apparatus ... ... (2nd cover).
Rivets 138
Riveting Hammers 167
Rolling Mills 128
Ropeways, Wire 214
Rotary Mills 1 180
Rough and Soft Goods 390 396
Rubber Goods 116 140

S.

Safes, Amalgam 176
Samplers, Enamelled 176
Sand Filling Pipes 200
Screening Plants 8
Screwing Machines, Pipe and Bolt 148
Screw Jacks 144
Screws, Coach 138
Series Gear... ... ... (3rd cover).
Shafting 1
Shearing Machines, Metal 144 148
Shearing Machines, Sheep and Goat 390
Shipping Companies 380 390 396
Shovels ... ... (2nd cover) 138
Signalling Apparatus, Mine 146
Skips 152
Smiths' Hearths 162
Soap 6
Sparking Plugs 409
Springs ... ... (3rd cover).
Stamp Batteries 280
Stamp Mills 8 120

Page.

Stamp, Gravity 178
Starters 152
Steam Hammers 140 144
Steam Traps 144
Steel Ceilings 4
Steel, Drill ... ... (2nd cover) 200
Steel, Manganese ... ... (4th cover).
Steel, Mining 138 140
Steel, Structural 1 278
Steel, Tool ... ... (2nd cover) 138 140 200
Stocks and Dies 144
Stokers, Chain Grate ... ... (2nd cover).
Structural Steelwork 5 128 280
Superheating Coils 200
Surgical Instruments and Supplies 176
Surveying Instruments 176
Switchgear ... ... (3rd cover) 1 128 146 206
Switchgear Instruments 128

T.

Tables, Filter 150
Taper Pins 144
Taper Reamers 144
Telpherage, Automatic 214
Testing Apparatus ... ... (3rd cover).
Theodolites 176
Threading Machines, Bolt 144
Threading Machines, Pipe 144
Timber Merchants 376 396
Tool Holders 144
Trackless Tram Systems ... ... (3rd cover).
Tramway Material 152 200
Transformers ... ... (3rd cover) 146 152
Transfits, Mining... 176
Trucks 1 152 154 200
Tube Mills 142 150 280
Turbines ... ... (2nd cover) 116 122
Turbine Plant 152
Typewriters 116
Tyres, Motor and Cycle 402
Tyres, Steel ... ... (3rd cover).
Tyre Protectors, Motor... 410

U.

Unloading Plant 128 214

V.

Valves and Fittings 200
Varnish 146
Ventilating Installations 280
Vises 144

W.

Wagon Tips 128
Washers 138
Waste Heap Dumping Bridges 214
Water Meters 142
Winders, Steam ... ... (2nd cover) 120
Windmills 146
Wire and Cable 116 126
Wire Ropes (2nd and 3rd covers) 138 142 158 160
Woodworking Machinery 144
Woodworking Tools 142
Wool and Mohair Brokers 390 396
Working Heads 146

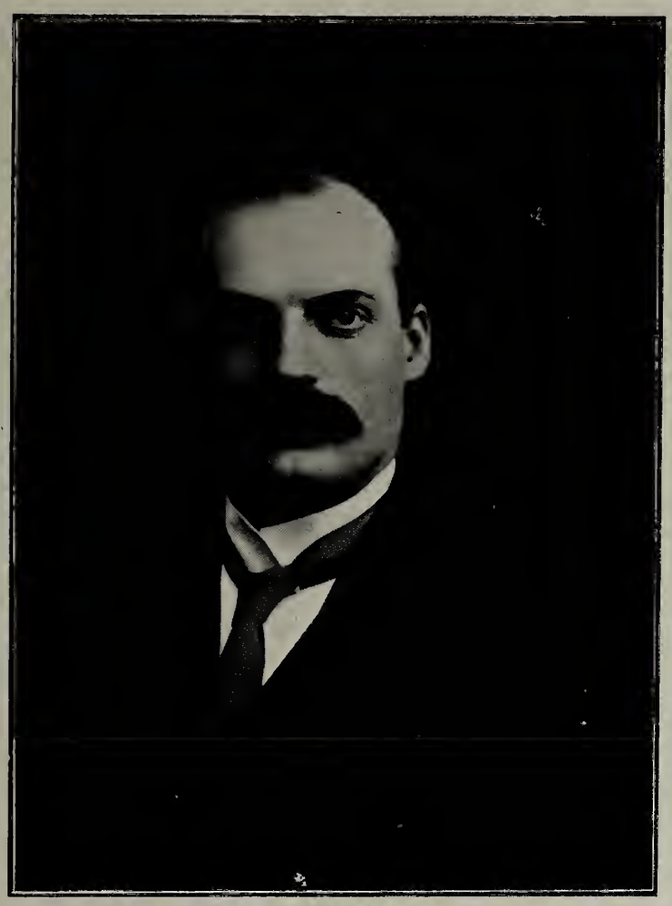


The South African Mining Journal

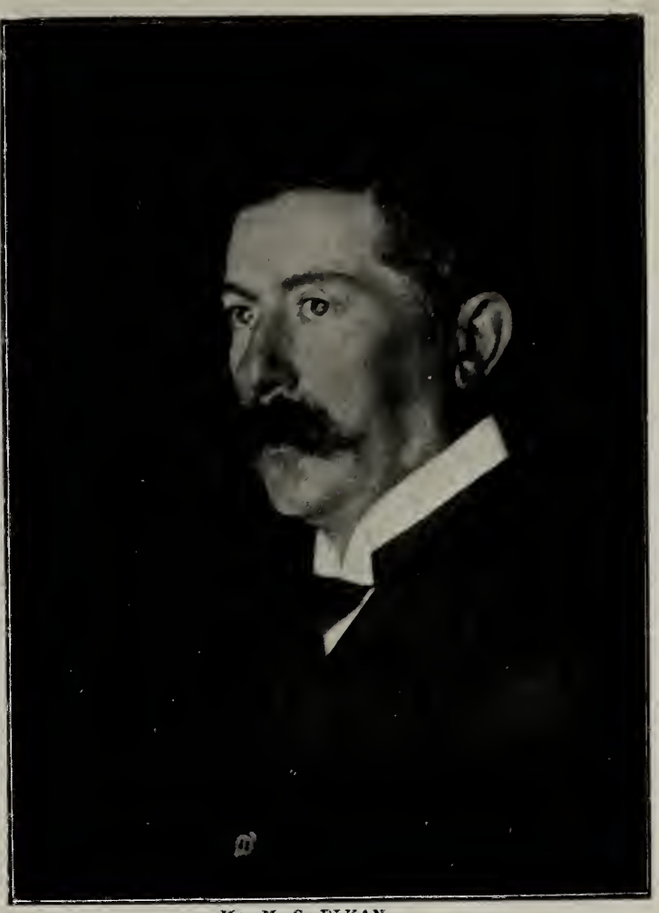
TWENTY-FIRST ANNIVERSARY NUMBER.

SEPTEMBER, 1912 — PRICE 3/6

Leaders of South African Mining.



Hon. A. MALAN
(Minister of Mines)



Mr. M. G. ELKAN
(President, Transvaal Chamber of Mines)



Sir LIONEL PHILLIPS, Bart.

Leaders of South African Mining



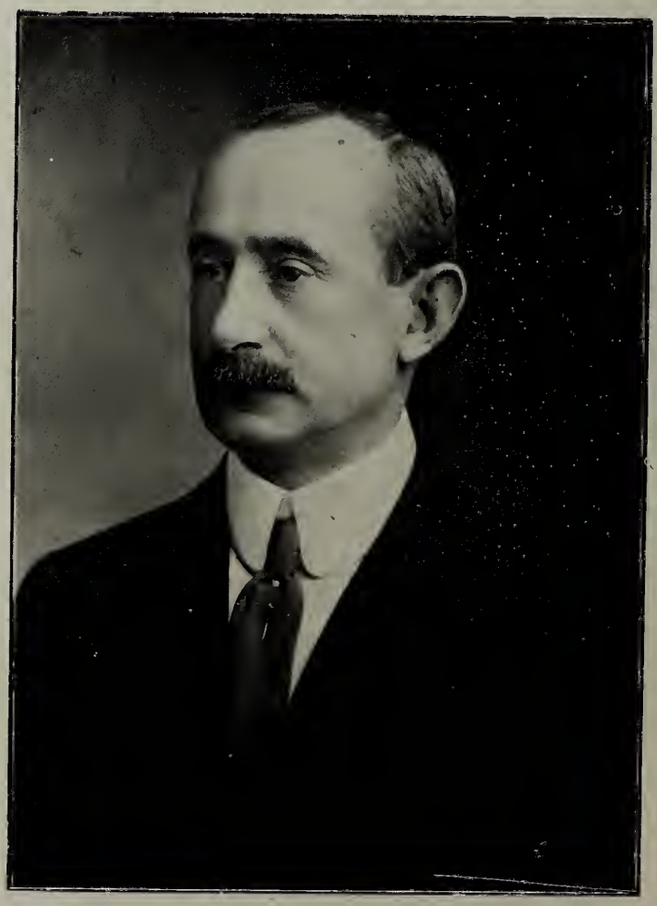
Mr. R. N. KOTZE
(Government Mining Engineer)



Mr. R. W. SCHUMACHER
(Central Mining and Investment Corporation, and Rand Mines, Ltd.)



Mr. A. BRAKHAN
(Chairman, Messrs. Goerz & Co., Ltd.)



Sir GEORGE FARRAR, Bart., D.S.O.

THE

South African Mining Journal

TWENTY-FIRST ANNIVERSARY

SEPTEMBER, 1912 PRICE 3/6

OUR "MAJORITY" NUMBER

THIS SPECIAL NUMBER is issued to commemorate the 21st Anniversary of the South African Mining Journal. Whether the high ideal we set before ourselves when the issue was planned has or has not been realised, we must leave the reader to judge. A few words on the policy that has guided and informed the whole may, however, be necessary to enable the reader properly to appreciate the work and its attendant difficulties. It was felt at the outset that if the whole field of South African mining and the commerce and subsidiary industries reared thereon were to be reviewed, there was a real danger of sacrificing the interest and attractiveness of the treatment to a mere passion for comprehensiveness. Therefore, it was resolved to have each phase of the mining industry and the rest dealt with by specialists—men who had something new to say where possible, and where novelty was not possible, possessed at least of the saving merit of authority. Too often ambitious annuals and much "boomed" special numbers resolve themselves into wearisome and ponderous masses of wholly indigestible summaries of facts. That danger to the merely industrious compiler we studiously sought to avoid. Instead, we have attempted to make the issue a landmark, a fresh starting point as well as a finishing post at the twenty-first mile of the journal's connection with South African mining. It is true that tribute has been paid to the insatiable demand for records, histories, reviews and the marshalled cohorts of statistics. These things have been done—it is hoped they have not been overdone—but they are not, and do not pretend to be, the features for which the number will be welcomed or remembered. The globular figures, graphically expressed, which portray mineral outputs, ore reserves, dividends, expenditure on machinery and on wages, furnish Rand mining with, perhaps, the finest advertisement that any industry has ever enjoyed. Too many, however, have treated of these things, and too many among the scribes and statisticians have succeeded in treating them so excellently that they have no claim on the public interest beyond their spectacular significance. Not in any of these "bread-and-butter" lines will the main interest and value of the issue lie. Rather do we pin our hopes to the thought-compelling contributions on different aspects of industrial activity supplied by men whose names are a household word throughout three continents; to the pictorial presentation of the mining industry in all its branches; to our portrait gallery of the men who have made and are making mining history in this country; and to the very magnitude and impressiveness of the vast field of human endeavour reared on the foundation of mining, which our pages attempt to portray. It would be unfair and unwise to single out names, but it is enough to say that, had it nothing else, the success is assured of an issue that contains articles by Messrs. Alfred James, G. A. Denny, Sidney Jennings, Professor Stanley, in the sphere of metallurgy; of Mr. H. F. Marriott, Professor Lawn, Mr. E. J. Way, Mr. Percy Cazelet, Mr. J. A. Vaughan and Mr. J. M. Calderwood in the world of mining engineering; of Mr. H. S. Harger, Mr. David Draper and Dr. Wagner in the world of geology; and of Lord Harris, Sir Sigmund Neumann, Mr. Gustav Imroth, Sir David Harris and Mr. R. G. Fricker in the world of finance. Other experts, only just less well-known and distinguished, are responsible for "rounding off" the issue; and the treatment of every subject has, therefore, the outstanding advantage of freshness, diversity and originality. If the account of the Rand is marked by some novel features, and has neither the abnormal length nor prolix repetition familiar in works of this sort, the fact, we believe, will win favour for us with the reader. A too liberal use of pictorial illustration there may be, but the fault, we believe, is in the right direction. Short of actual treatises on metallurgy, no more complete, certainly no more authoritative account of Rand ore reduction processes, their history and progress, has ever appeared. A galaxy of brilliant writers, who are also famous

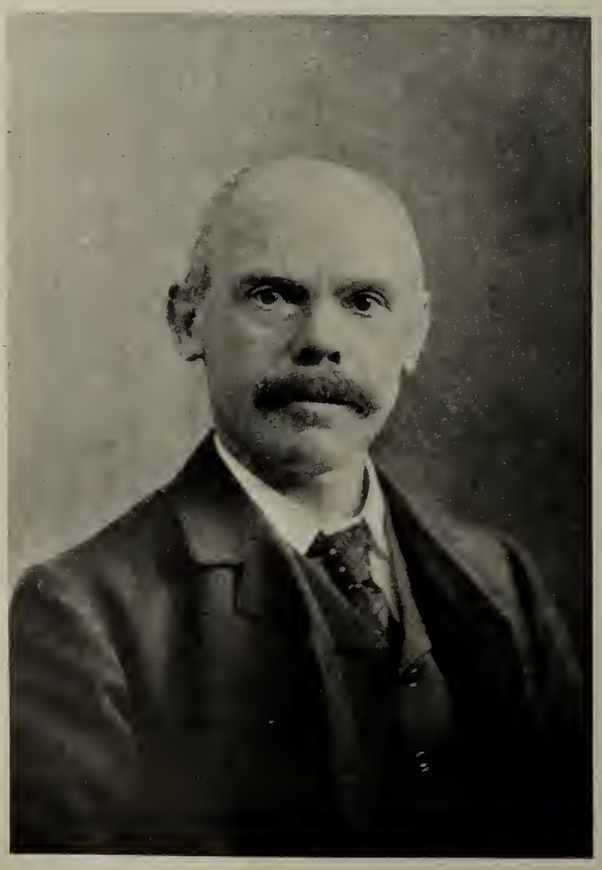
Leaders of South African Mining *(Continued).*



SIR GEORGE ALBU, Bart.



Mr. W. L HONNOLD
(Consulting Engineer, Consolidated Mines Selection)



Mr. JOHN MUNRO, of Messrs. Barnato Bros.
(Vice-President Transvaal Chamber of Mines)



Prof. J. G. LAWN
(Consulting Engineer, Johannesburg Consolidated Investment Co., Ltd.)

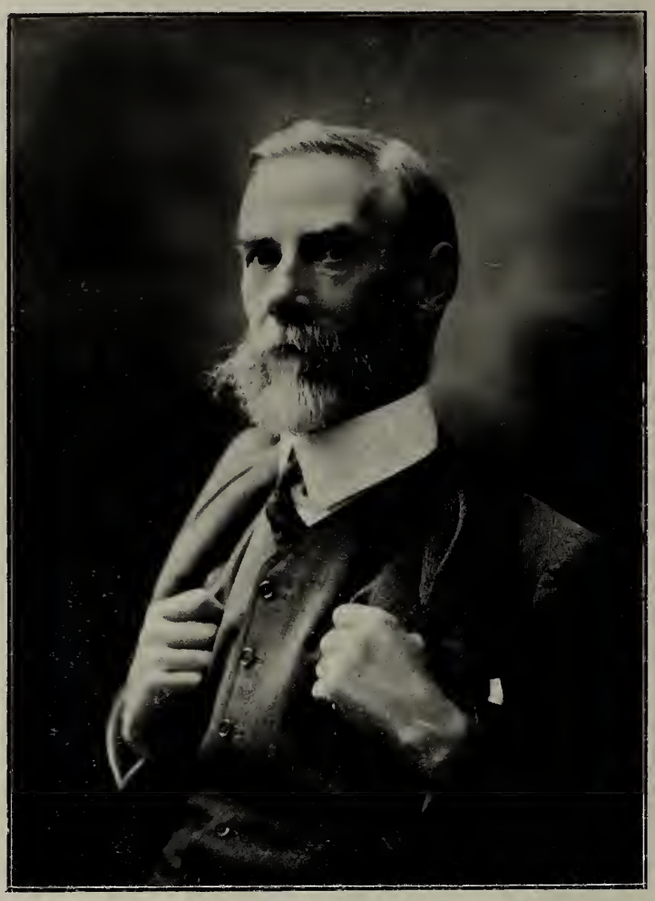
scientists, are responsible for this section. Of Rand mining proper, a big feature is made; and the men who deal with it are men who have won through to the top of the tree in their profession. Nor are the outside districts neglected. To those cinderellas of the industry the South African Mining Journal has always played the part of fairy godmother, and their prospects have occupied a comparatively large share of attention in our pages. Rhodesia, Zambesia, Manicaland, Katanga, German South-West Africa—all find a large and roomy niche in the structure. Diamonds, tin, coal and copper are dealt with as they deserve to be dealt with—broadly, generously, with a proper conception of the enormous part they are destined to play in the future of mining in South Africa. Where possible, the industries subsidiary to mining are accorded due treatment. Whole sections, moreover, are devoted to commerce, under the guidance of experts; to agriculture by some of our foremost writers on that fascinating theme; to banking by its leading authorities; to insurance and insurance companies by men who have the intricate facts of these great divisions of finance at their finger tips. Electricity, that many-engined revolutionary of modern industry, and such outstanding developments of engineering as automobilism find due place in the work, and, short of the easy comprehensiveness of an omnibus, nothing relevant to industrial progress in South Africa is ignored. Where omissions have occurred, or where a nice proportion has not been observed in allocating space, the reader's tolerance is craved. "There is a reason." If some phase of industry is overlooked, or some important point is ignored, be assured the blame must lie with the indifference, or apathy, or both, of those mainly concerned. We have done our best.

RAND MINING IN PICTURE—THE SIMMER DEEP, LTD.



1. Simmer Deep-Jupiter Joint Slime Plant. 2. Simmer Deep-Jupiter Joint Tube Mill Plant—Fifteen Tube Mills in line. 3. Headgear and Ore Bins at the Milner Shaft. 4. Simmer Deep-Jupiter Joint Plant—Caldecott Cones and Tables. 5. Simmer Deep-Jupiter Joint Sand Plant.

Leaders of South African Mining *(Continued).*



Mr. SAMUEL EVANS
(Chairman and Managing Director, Crown Mines, Ltd.)



SIR J. W. S. LANGERMAN
(Robinson Group)



SENATOR SAMUEL MARKS



SIR PERCY FITZPATRICK, K.C.M.G.

The Beginnings of Rand Mining and of the "Mining Journal"

How both came into being, and how the Paper and the Industry were first interwoven.

By COLONEL R. A. BETTINGTON

THE beginnings of Rand mining and of the "South African Mining Journal" were closely interwoven. No one connected with these fields in the early days cared a brass farthing for journalistic effusions, except in so far as they could be suborned to furthering their own particular interests. No one knew anything of mining under the peculiar conditions of the Witwatersrand, but that mattered naught, for everyone reckoned he knew everything worth knowing. When the first discovery was made that the curious formation resembling nothing less than cold plum pudding with lumps of suet sticking in it was highly charged with free-milling gold, there was only one thing to be done. Get it out as fast as possible, crush it, run the stuff over mercury-covered plates, recover what could be scraped off, and never mind the remainder.

The first procedure was to peg off the claims, sample the ore, float a company, order a crushing plant, get a big return per ton, boom the shares, and then sell out. Thus was the first money made. Before long the Reef was honeycombed with great holes in the way of open workings. The celebrated Ferreira Mine, even then one of the richest, became a huge chasm which got filled with water. The ore was carted in Scotch carts all the way to Auckland Park, where, for the sake of running water, the mill had been erected. Where shafts were sunk, the water was pumped out by means of huge horse-driven wheels and allowed to run to waste, as no one thought of conserving. I remember being laughed at for suggesting such a course.

Of course, mining experts were to the fore. They signed themselves C.E. after their names, this title being self-conferred. One of the most successful was an ex-carpenter, who in his unscientific days I have often seen planing planks. He was an ingenious fellow, and invented a stamp battery with returning action, but it never got beyond the model stage. He made a reasonable fortune, and wisely cleared out in time.

The early indications pointed to the reef being vertical, and a friend of mine, who represented a colonial syndicate, finding he could get no claims on the main reef outcrop, pegged off a line on the first southern dip. He was roundly abused for his foresight and ordered to abandon the claims and not waste the syndicate's money on such rubbish. In justice to the carpenter-engineer, it must be said that he pointed out the probability of the reefs dipping southward, but many insisted that they were merely surface formations and would run out at a depth of between sixty to one hundred feet. The main responsibility for denouncing the dip theory lay, I believe, upon a very wealthy and betitled magnate of the present day, whose profound, but unsound, opinions resulted in the loss of millions to the industry, which, but for his positive assertions, might have acquired all their deep levels at the cost of the monthly licences.

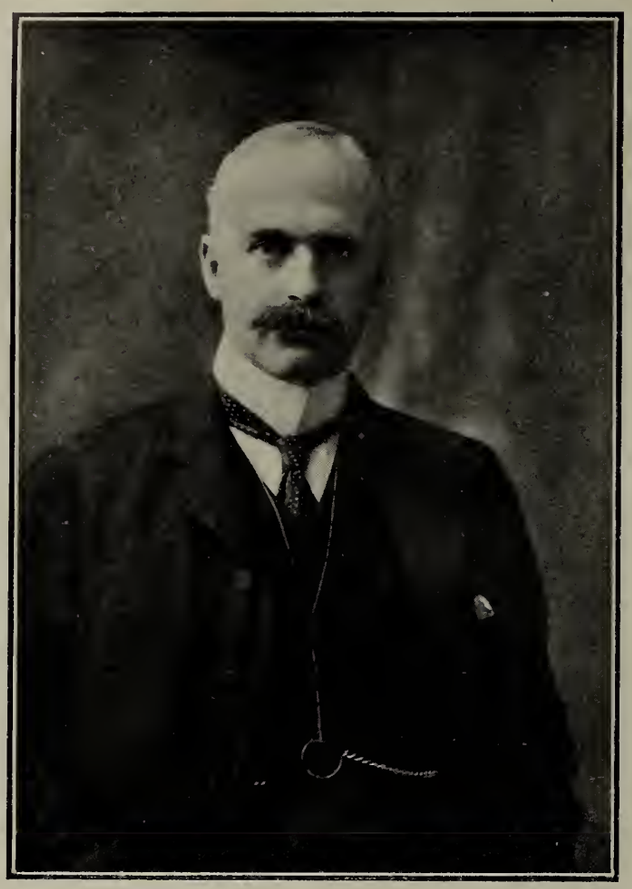
To the privileged visitors of to-day, who are taken several thousand feet in electrically-driven lifts, and stand amazed at all the marvels of mechanical ingenuity and the various devices for labour saving and ultimate extraction, a sight of one of the old mines would have been somewhat comical. Where there was a shaft, one was lowered by a windlass in a big iron tub holding three or four people, and generally bumped into a pool of water. Otherwise one went down holding on to a rope, with one foot in a stable bucket. The old Chimes, that I was asked to inspect for an absentee shareholder, was nothing but a huge rabbit warren, where an erratic progress had to be made mainly on hands and knees. The first real difficulty that faced the early miners was the appearance of rock charged with pyrites. At the surface and to the depth of about fifty feet the rock, under the effect of the oxygen and water, was free milling, but when a depth was reached outside those influences, it was found that terrible wastage took place over the plates. This necessitated the use of the various processes which have since come into existence for the treatment of sand and slimes. Before an efficient system was established, with the construction of dams, it may safely be estimated that hundreds of thousand of pounds worth were carried into the kloofs and low groun dto be swept away by every flood.

After a few years of this wasteful production, when the eyes of mines were ruthlessly picked out, and it was ascertained that the depth of the reefs was practically unlimited, a new system had to be introduced. The method of shaft-sinking and driving was introduced. Huge dams for the conservation of water were constructed at enormous cost, and the whole elaborate apparatus of mining as we know it to-day had its inception. Self-appointed C.E.s had to give way to mining experts, who at one time only rang the changes on the superlative of the "Harp struck by lightning." Investors wanted to know actual facts beyond what were supplied in laudatory articles penned by venal scribes inspired by free options or actual delivery of shares. The tired gentleman taking his seaside holiday and reluctantly compelled to give the straight tip which converted good cash into subsequent trunk linings was getting played out.

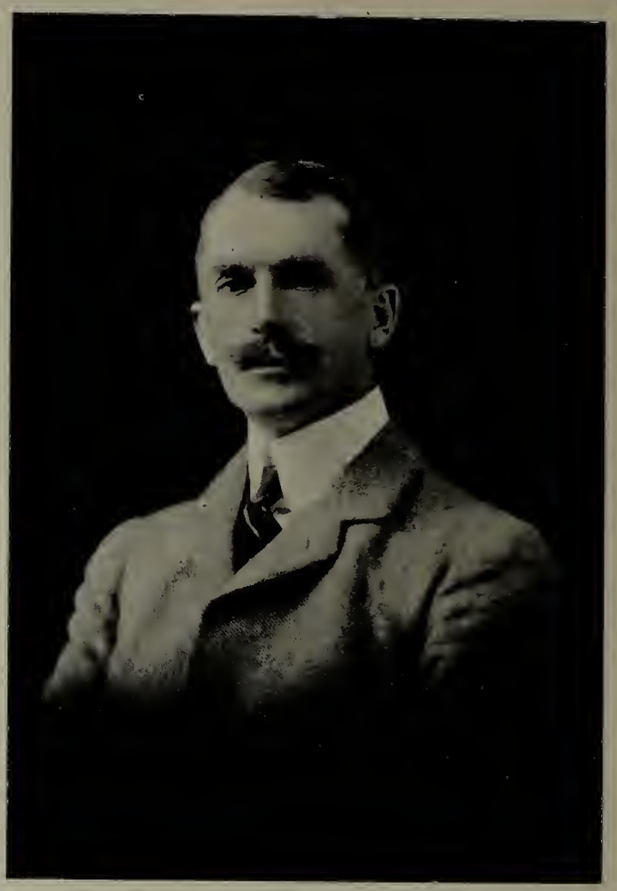
A "Mining Journal" existed as early as 1887, but it was mainly the vehicle for printing prospectuses or recording the fact that some company had completed a colossal equipment of twenty stamps, and that another company had or was going to put down a shaft. It was, besides, a kind of printing phonograph recording the utterances of the voice of the charmer melodiously proclaiming the virtues of wild-cat ventures. Who could blame the poor paper? It had nothing else to do, and if a report from the well-known and highly-respected Mr. Crossways, M.I.C.E., was sent in for publication—and paid for—well, it had to go in.

The Great Slump of 1891 was passing over when, on September 19th, 1891, the "South African Mining Journal and Financial News" first made its appearance with the sub-title of "A Journal for Investors, Mining Engineers and Managers." A few lines in the concluding paragraph of the usual editorial apologia with which every newspaper launches itself are worth noting: "It is not without a hope that this journal may have its beneficial effect upon the interest which it represents

Leaders of South African Mining *(Continued).*



Mr. F. D. P. CHAPLIN
(General Manager, Consolidated Goldfields of S.A., Ltd)



Mr. W. H. DAWE
(Messrs. Neumann & Co.)



Mr. E. A. WALLERS
(Joint Manager, Central Mining and Investment Corporation, Ltd.)



Mr. H. C. BOYD
(Joint Manager, Central Mining and Investment Corporation, Ltd.)

that its proprietors despatch it on its career." The paper appeared at first in a fortnightly issue, but after the second number it was decided to produce it weekly, as at present. The first number covered twenty pages, and contained the text of the "Amended Gold Law"; a table of mileage from Johannesburg to Fort Salisbury, for the information of intending travellers to Mashonaland and Matabeleland; a paragraph on the appointment of Mr. Klimke as State Mining Engineer; Kimberley notes; a report of the monthly meeting of the Chamber of Mines, in which one notes that complaints from several managers had been received as to the quality of Transvaal dynamite. Then come the reports of various companies; an article on electricity for mines, forecasting many of the uses to which it is put at present; mining intelligence; monthly return of the output, which in August, 1891, amounted to 59,070 ounces, with an average yield of 12.11 dwts. per ton; report of the sharemarket, where an advance of twenty per cent. on good stocks is noted; ruling prices of mining material; information to the effect that the Chartered Company possesses sufficient funds for two years; Zoutpansberg note, in which "great anticipations are entertained as to the crushing now taking place at the Birthday"; coal mining notes; legal; mineral discoveries, including a strike of antimony at Steynsdorp; Barberton notes; and lastly some pages of advertisements, the most beautiful feature of any paper from the proprietor's point of view.

The third issue of the paper announces the absorption of the "Witwatersrand Mining and Metallurgical Rewiew," edited by Mr. E. P. Rathbone. Among the "Personalia" in this same number, the following takes one back considerably: "Mr. Rhodes and party at M'Panda," "Lord Randolph Churchill has been advised to go Home by some other route than the Transvaal. If he comes back to the Rand, it is hoped he will have learnt some wisdom, and not depend wholly for mining advice on Mr. Perkins, who has enjoyed a valuable experience in Venezuela, but knows nothing of this conglomerate formation and its peculiarities." The foreging advice was apparently taken, for in the next issue we read that "Lord Randolph Churchill is reported to have left Manica on the 8th instant with the intention of shipping from Port Beira on the 10th proximo. It is said that he is disappointed with Mashonaland." I leave the rest of the story of the paper's rise and progress to other pens.

THE HISTORIC STOPE DRILL TESTS AT THE ROBINSON.



"South African Mining Journal" Machine Drill Trials, Robinson Mine
Visit of Lord Selborne.

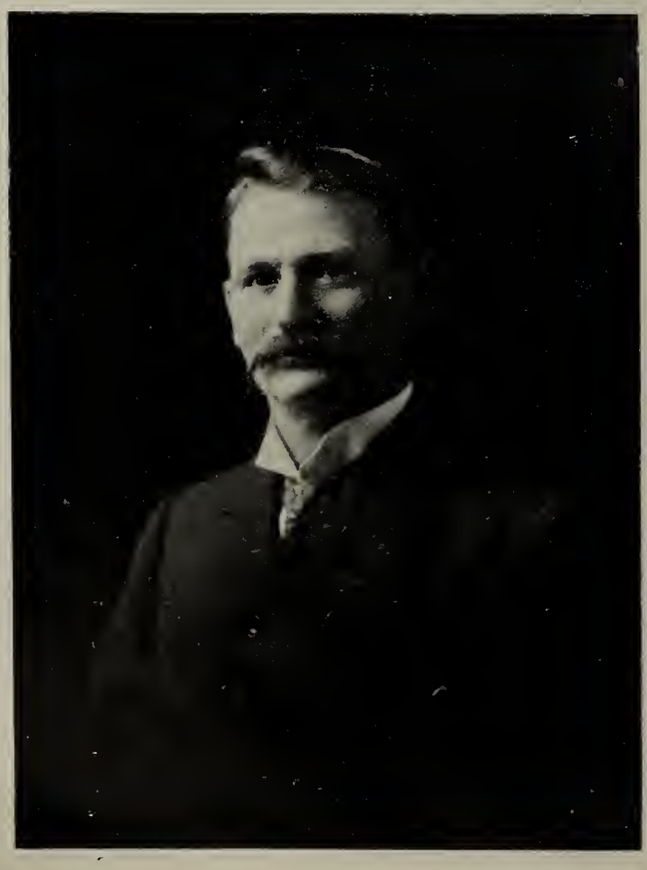
Leaders of South African Mining *(Continued).*



Mr. GEORGE NATHAN
(Joint Manager, General Mining and Finance Corporation, Ltd.)



Mr. ARTHUR FRENCH
(Joint Manager, General Mining and Finance Corporation, Ltd.)



SIR THOMAS CULLINAN, M.L.A.
(Chairman, Premier Diamond Mining Co., Ltd.)



Mr. B. MADEW
(Consulting Engineer, Rand Mines, Ltd.)

The History of the "South African Mining Journal"

The Contemporary and Chronicler of the Rand :: Its Contributions to the Economic and Scientific Progress of South African Mining :: A Glance at the Past

WITH this issue, the "South African Mining Journal" commemorates its twenty-first year of existence, and its tenth year of publication since its resuscitation after the war. The history of the journal is the history of the Rand; it has grown as Rand mining has grown, and the highest tribute paid to the value of the paper is its general acceptance as the fit and worthy organ of the unique industry, whose rise and progress have astonished the world. In this issue we attempt to sketch the history of the journal, and to indicate, we trust without overstepping the bounds of modesty, the part played by it in promoting scientific progress and economic reform within the industry. Looking back over the pages of the past, we cannot fail to be struck by the effect on the fortunes, prestige, and popularity of the journal of those dynamic spirits who guided its youth and growth. To the traditions of hard work, enterprise, and enthusiasm handed down by them, the paper owes to-day much of its influence and authority. The men who helped to build it have all left their impress on the journalism of the Rand and on the larger field of technical literature throughout the world. Editors and contributors alike have given of their best to these pages, and their names, if reprinted here, would read like a directory of the best-known writers associated with the mining industry. Apart from the actual contributors, there is the large and public-spirited body of mining men of all ranks to whom we have always been—and still are—indebted for much of the information and advice that goes to swell the value of our pages. To all these unrewarded and unobtrusive friends it is fitting and usual for us to make acknowledgment on an occasion such as this. To commemorate the anniversary, it will be seen that an effort is made by the inclusion of many special features and a number of interesting illustrations to increase the size, scope, and interest of this issue. Indeed, in mere point of size and variety of contents, this number can fairly claim to be memorable as well as typical of progress in South African mining journalism.

Early Beginnings.

From its beginning in 1891 as a weekly paper until the outbreak of war in 1899, the "Journal" appeared with unbroken regularity, although under various proprietarial changes, and was distinguished not only for its faithful and unbiassed record of mining facts, but for its pioneering ability and suggestiveness in the field of further industrial betterment. Many leading groups were from time to time interested financially in the paper, which was then managed by its present proprietor, Mr. Clem D. Webb; but the proprietorship was so broadly spread amongst the houses of those days that the impartiality and integrity of the general conduct of the "Journal" were completely secured. After the war this function of collaboration with the best technical and commercial thought of the Rand became even more peculiarly associated with this paper, by the transfer of all rights in the "Journal" to Mr. Clem Webb as sole proprietor, whose business it has systematically been to make it represent the whole industry, and not any part of it. To-day the paper may claim without effrontery to be recognised as the sole authority on South African mining and commercial matters all over Europe and in America and Australia; it is more widely quoted for facts of permanent interest than any other publication in this country. Most of the leading financial papers in those continents reproduce its articles with regularity and freedom.

Contributors and Editors.

Amongst our contributors in the past and present we can count such names as those of Messrs. John Hays Hammond, Hennen Jennings, Hubert Davies, George Denny, H. S. Denny, A. R. Sawyer, Sir Percy Fitzpatrick, Dr. F. H. Hatch, and many more of greater or lesser celebrity. There was "so little done so much to do" in the days when the cyanide process had not yet come to solve the problem of pyritic ores then beginning to show in depth; when Butters was introducing the chlorination process at the Robinson Mine, whose directors were always foremost in their generous encouragement of scientific experiment; when (in April, 1892) the average duty per stamp per day was the ludicrously low figure of 2.67 tons. We are to-day able to export such men, home-made, to wherever they may be needed; but it was Perkins and Hamilton-Smith, and the Jenningses, and Hays Hammond, George E. Webber, H. H. Webb, Hellmann, and others of world-wide-known names, who slowly and steadily rehabilitated the Rand after its great disaster. They were not selfish in their generation; they taught and showed the best to all comers, and made free use of the pages of the "Journal" to do so. Many have held the editorial chair. Mr. E. P. Rathbone, Mr. Wilson-Fox (the Manager of the Chartered Company), Mr. C. F. Tainton, the late Mr. John Stuart, Mr. A. E. O'Flaherty, the late Mr. R. J. Pakeman, and the late Mr. H. Clayton have all preceded its present occupant.

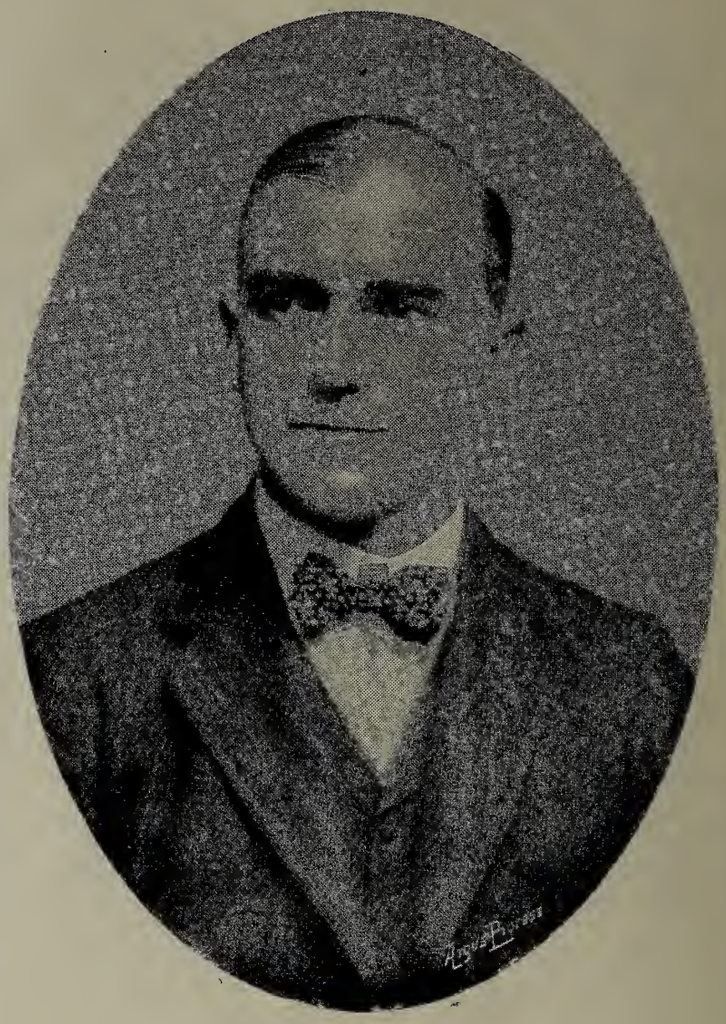
A Notable Tribute.

The late Mr. Pakeman brought the history of the paper up to seven years ago. Writing in 1905, after he had severed his connection with the "Journal," he recorded how in these pages were originated many fruitful but now familiar scientific processes. "The paper," he wrote, "was the first to suggest the sorting of ore and the addition of rock-breaker houses in 1890. It recommended the self-dumping skip, and advocated the conversion of waste coal into electrical power. It 'wrote up' cyanide before cyanide was here, and agitated for the direct delivery of coal in bulk to the mines and the provision of side-tracks from the main line for that purpose. It projected huge mills when the one hundred-stamp mill was yet a colossal and audacious idea. It urged, and successfully urged, the merits of concentrating tables and Ingersoll-Sargeant rock drills, and in the region of accurate 'costing' per ton milled it successfully pioneered the first-class work of that kind which is done on every established mine to-day. From its pages sprang the Mine Managers' Association and the South African Association of Engineers; and

Leaders of South African Mining *(Continued).*



Mr. DONALD MACAULAY, M.L.A.



Mr. RUEL C. WARRINER
(President, Rand Mine Managers' Association)



SIR DAVID HARRIS, M.L.A.



Mr. SAMUEL THOMSON
(Consulting Engineer, Neumann Group)

it was unceasing, in an era of State indifference, in its advocacy of the formation of a Technical Institute, which has only been realised under British government. It fought for discrimination between the fit and the unfit in skilled mining work, for State supervision and certificate; it fought for the introduction of adequate mining regulations in the interest of the miner; and in the great war against the vicious Dynamite Monopoly, which fed like a vampire upon the vitals of the industry, it took a foremost and formidable place."

Writing of the same strenuous days, another former editor, Mr. C. F. Tainton, said: "The mines and the miners were to play a great part in the Jameson Raid; but when Jameson failed to get through—he chose the time of full moon—it was decided that thirty thousand cartridges would not suffice to carry the revolt to a successful issue. All the leading men connected with the mines found themselves inside Pretoria Gaol, the "Star" newspaper was suppressed, and for the first time in its history the "South African Mining Journal" found itself in some degree a political organ. Detectives began to stroll about its premises, and messages were received from Dr. Leyds threatening suppression. But the political movement could not be stayed, until finally the South African League came into being. Its leading principles were drafted in the "Mining Journal" office, forwarded for adoption to the Cape Colony and Natal, and an active propaganda began which ended in the final breaking down of the barriers which had prevented the amalgamation of the old and the new."

Recent History.

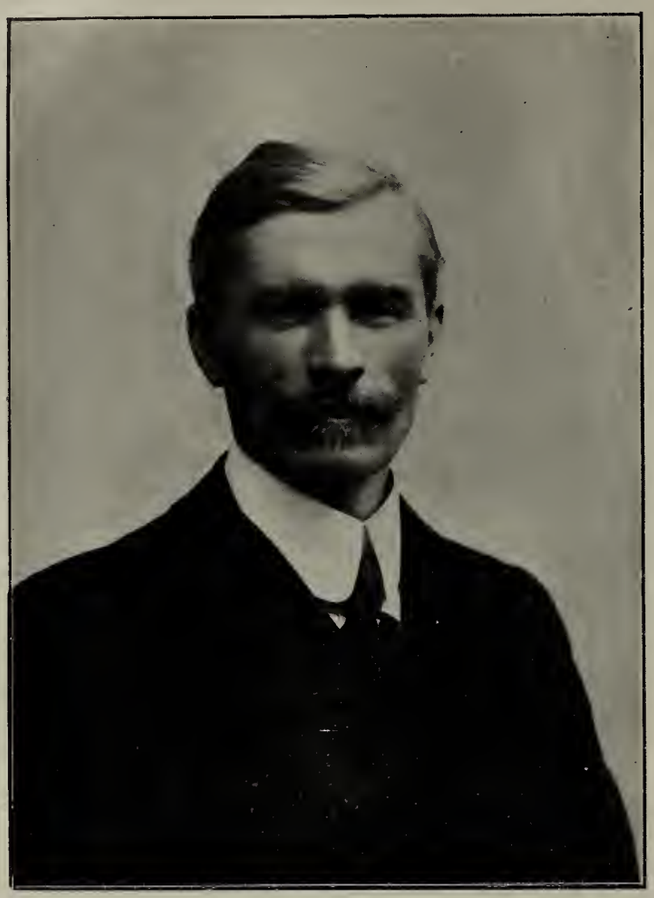
The more recent history of the "Journal" is not less intimately bound up with the history of the industry. It wrote up tube mills and filter-pressing when these things were almost unknown on the fields. It started and maintained the movement that culminated in the sweeping reduction of working costs. It never failed, however, to insist upon the danger of sacrificing maximum profits to minimum costs. It examined the wages system and general hygienic conditions of the mines when little attention was given to these matters, and many of the improvements recommended three and four years ago are being introduced to-day. It foreshadowed and set out in great detail the whole case for amalgamations when that momentous alteration in the industry was undreamt of by the general public, and it discussed and debated in all its forms the question of electrifying the mines of the Rand by the introduction of mammoth central power stations. When Rhodesia was still in the cold shades of public disfavour, it reported on and confidently recommended the more promising propositions of that country to the investing public in Europe and South Africa. It advocated the employment of stope-drills before the Rand woke up to the value of those important labour-saving devices, and the competition organised by the proprietor (Mr. Clem D. Webb), out of which the Government cum Chamber of Mines Stope Drill Contest grew, was one of the most successful and useful undertakings promoted by the paper—perhaps, indeed, by any technical paper. The sympathy and interest shown by Lord Selborne on that occasion will long be remembered as a striking example of the tact and understanding that marked His Excellency's attitude towards the great industry of the Rand. Among the matters that engaged the attention of the "Journal" more recently may be mentioned the great problem of phthisis and artificial ventilation on the Rand, the equipment of the Angelo section of the E.R.P.M. being first brought to public notice through our columns. Sand-filling in stopes, which promises to remove the unsightly dumps from the surface, and the danger of subsidences below, was also first adequately described in the "Journal." We have not attempted to survey the vast agglomeration of technical literature that has filled our pages on such ever-present problems as Rand geology, the tin mines, big mills, underground mechanical haulage, pumping, hoisting from great depths, temperatures, reef vagaries, air pressures, heavy stamps, modification of cyanide practice, accidents, labour matters, and the outstanding questions of hygiene and education, and their bearing on the future manning of the mining industry. These are matters still for the most part in the melting-pot; they will continue to excite discussion and to demand space in our columns for many years to come. Nor do we fear that what we shall have to say regarding them will be any less important or will appeal to a lesser audience than in the past. On the contrary, it will be the mission and privilege of the "Journal" to spread a knowledge of the industry and its manifold problems through all the States of the Union, whose representatives now have the destinies of the industry in their keeping. That, surely, is an ambition which, added to our other aims, should ensure for our readers and supporters that in interest, scope, and value the "Journal" in the coming years will suffer no diminution, and that the qualities and features that have raised it to its present position will be maintained and improved.

It is usual on these occasions to say a word about the future. We are conscious that there are many directions in which the paper can be improved. Without departing from our declared policy of constructive criticism, there is no reason why the growth of interest in mining outside the Rand should not provide us with innumerable opportunities for guiding, informing, and protecting the interests of investors. The "outside" gold mines, base metal propositions, Rhodesian ventures —the records of these will relieve the possible monotony of pages devoted to the unexciting development of the deep-deeps, the progress of mine sanitation, and the search for new Rands. Moreover, the peaceful revolution in the generation and transmission of power that is now in progress will, with other engineering reforms, keep interest alive in our pages. The aim of the paper will continue to be faithfully to chronicle the growth of the whole industry, and the extended application of science to its many phases and problems. It will be our endeavour to report the current controversies of geology, chemistry, engineering, and mine hygiene with fairness and honesty; our columns will always be open to free discussion of the whole range of topics cognate to mining, and no views, honestly held and expressed in good faith, will be denied a hearing merely because they do not happen to be our views. In the future, as in the past, it will be our ambition to produce a journal useful to all, unfair or injurious to none, and the worthy organ and chronicler of the great industry that has, literally, been the making of South Africa.



General Mining Buildings, Marshall Square, Johannesburg

Leaders of South African Mining *(Continued).*



Mr. E. E. WAY
(Consulting Engineer, Anglo-French Group)



Mr. H. C. BEHR
(Consulting Mechanical Engineer, Consolidated Gold Fields of S.A., Ltd.)



Mr. H. S. HARGER
(President, Geological Society of South Africa)



Mr. PERCY CAZALET
(Consulting Engineer, Rand Mines, Ltd.)

The Mines and the "South African Mining Journal"

Letters of Appreciation : Striking Tributes from the Leaders of the Industry : The Houses Record their High Opinion of the Paper : A Series of Unique Testimonials

The following striking tributes from the leading houses of the Rand, which constitute an unique testimonial to the value and importance of the "South African Mining Journal," are printed with the consent of the writers. They speak for themselves.

H. Eckstein & Co.

Telegraphic address: "Eckstein."

P.O. Box 149, Johannesburg. Transvaal.

25th October, 1910.

To the Proprietor, "South African Mining Journal," Johannesburg.

Dear Sir,—It affords me pleasure to state that the "South African Mining Journal" has, in my opinion, been honourably conducted during its existence of 20 years, and is an organ in which I have placed great confidence.

It is to a large extent due to its influence that many improvements have been effected in mining methods. As the only strictly mining paper here it enjoys a wide circulation in South Africa, and is filed by all responsible mining men, as well as by those who have the placing of orders for the requirements of the industry. It is an excellent advertising medium, and may, I think, be used with advantage by merchants and manufacturers for that purpose.—Yours faithfully,

LIONEL PHILLIPS.

The Consolidated Gold Fields of South Africa, Limited.

(Incorporated in England)

P.O. Boxes 67 & 1167.

Telegraphic Address: "Giovano."

Telephone Nos.: 953, 954, 955 & 956.

Johannesburg, Transvaal.

4th October, 1910.

The Editor, "South African Mining Journal," Johannesburg.

Dear Sir,—I have much pleasure in stating that the "South African Mining Journal" is the recognised organ of the Mining Industry in this country; it circulates amongst all Directors Managers, Engineers and those who have the placing of orders for the requirements of the Mines of South Africa. I consider that the "South African Mining Journal" is an excellent advertising medium and deserves the support of all those who are interested in the advancement of the Mining Industry of this country. It also has a wide and influential circulation amongst the leading Commercial people of South Africa.—Yours faithfully,

F. D. P. CHAPLIN, Joint Manager.

Public Men connected with the Industry



Mr. J. A. YULE
(President, South African Institution of Engineers)



Mr. D. C. GREIG
(Chairman, Johannesburg Stock Exchange)



Mr. FRED ROWLAND
(Secretary, Chemical Metallurgical and Mining Society)



Mr. W. F. HARVEY
(President, Witwatersrand Commercial Exchange)

Appreciations of the "South African Mining Journal" by the Industry

(CONTINUED)

H. ECKSTEIN & Co.

TELEGRAPHIC ADDRESS:
"ECKSTEIN."

P.O. BOX 149,
JOHANNESBURG,
TRANSVAAL.

26TH SEPTEMBER, 1910.

THE EDITOR, "SOUTH AFRICAN MINING JOURNAL," JOHANNESBURG.

DEAR SIR,—We have pleasure in stating that the "South African Mining Journal," which has been published for the past twenty years, is a weekly organ devoted to the Mining Industry, and, as such, receives much information direct from mining companies. It circulates among Mine Managers, Engineers and those who have the placing of orders for the requirements of the mines in their hands. We have no hesitation in saying that the "South African Mining Journal" is a most useful and interesting paper, and valuable particularly to those interested in the mining industry of this Country, whose support it thoroughly deserves.—Yours faithfully,

p.p. H. ECKSTEIN & Co., C. DISTEL, H. C. BOYD.

A. Goerz & Co., Limited.

(INCORPORATED IN THE TRANSVAAL)

JOHANNESBURG TELEPHONE
NUMBER 92.

JOHANNESBURG TELEGRAPHIC ADDRESS:
"BRICK, JOHANNESBURG."

Silesia Building, Main Street,
P O. BOX 1156.
Johannesburg,

13TH OCTOBER, 1910.

THE EDITOR, "SOUTH AFRICAN MINING JOURNAL," JOHANNESBURG.

DEAR SIR,—We have pleasure in testifying that the "South African Mining Journal," which is the recognised organ of the Mining Industry in this country, enjoys a wide circulation amongst those directly and indirectly interested in the exploitation of the mineral resources of South Africa. It is a very interesting and reliable paper and is undoubtedly a first-class advertising medium.—Yours faithfully,

p.p. A. GOERZ & Co., LTD., M. ELKAN, Joint Manager.

Public Men connected with the Industry *(Continued).*



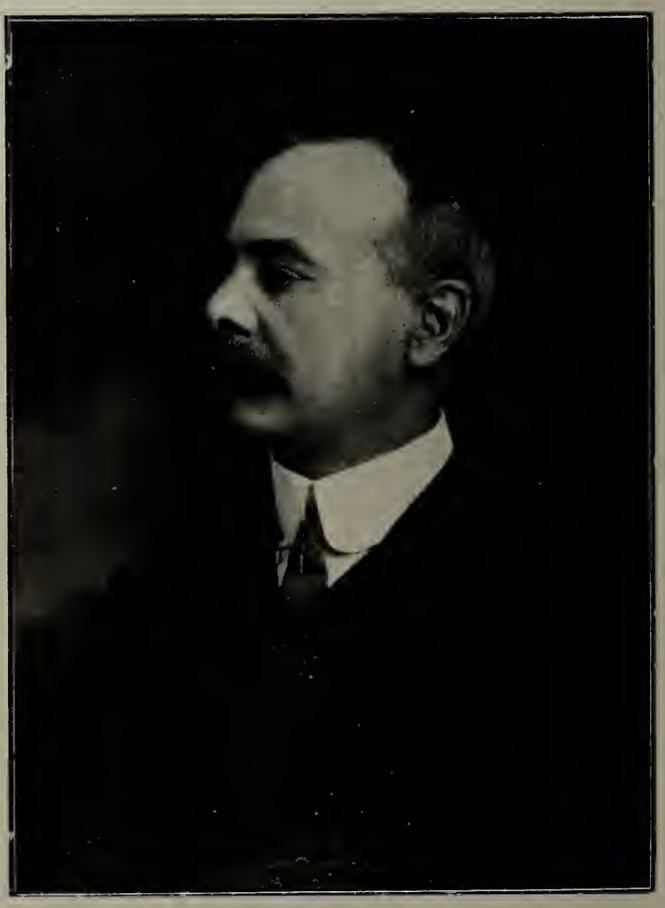
Mr. H. J. HOFMEYR
(President, Rand Pioneers)



Mr. C. B. SANER
(Past President, Chemical, Metallurgical and Mining Society)



Mr. C. A. FERGUSON
(General Manager, Randfontein Central)



Mr. J. H. RIDER, M.I.C.E., M.I.E.E., M.I.Mech.E.
(President, S.A. Institution of Electrical Engineers)

THE JOHANNESBURG CONSOLIDATED INVESTMENT COMPANY, LIMITED.

MINING DEPARTMENT.

Telegraphic Address:
"CONSOLS."
Telephone No. 3109.

P.O. Box 590.
Johannesburg,
TRANSVAAL.

12TH OCTOBER, 1910.

THE PROPRIETOR, "SOUTH AFRICAN MINING JOURNAL," JOHANNESBURG.

DEAR SIR,—It affords us pleasure to testify that so far as the Mines connected with this Group are concerned, your publication is the recognised organ of the Mining Industry in this part of the world, and also that it is circulated amongst all those who are interested in mining matters in South Africa. We further invariably use it as the advertising medium, when publishing the Mining Companies' Reports and Statements of Account.—Yours faithfully,

J. MUNRO, Chairman, BARNATO GROUP OF MINES.

Compagnie Francaise de Mines d'Or et de l'Afrique du Sud.

JOHANNESBURG P.O. Box 3258.
TEL. ADDRESS: "COFRADOR."
PARIS: 20, RUE TAITBOUT.

Exploration Buildings,
Johannesburg,

OCTOBER 8TH, 1910.

THE EDITOR, "SOUTH AFRICAN MINING JOURNAL," JOHANNESBURG.

DEAR SIR,—The "South African Mining Journal," is a weekly publication that has had the support of those interested in Mining for the past twenty years of its existence as an organ devoted to the interests of the Mining Industry in South Africa. It has a wide circulation among Directors, Managers and Engineers of Mining Companies, and also among those commercially interested in mining. I therefore have pleasure in testifying to its excellence as an advertising medium, and recommend it to all those who are interested in the welfare of the Mining Industry, which its advocacy has greatly assisted in advancing.—Yours faithfully,

H. O'K. WEBBER.

GENERAL MINING AND FINANCE CORPORATION, LIMITED.

TELEGRAPHIC ADDRESS:
UBLA, JOHANNESBURG.

TELEPHONE:
JOHANNESBURG No. 3041.

ALL COMMUNICATIONS TO BE ADDRESSED TO THE SECRETARY.

P.O. Box 1242.
GENERAL MINING BUILDINGS,
MARSHALL SQUARE,
JOHANNESBURG,
TRANSVAAL.

14TH OCTOBER, 1910.

TO WHOM IT MAY CONCERN.

We have pleasure in stating that we have for many years subscribed to the "South African Mining Journal," and that its columns have afforded us much useful and interesting information. We know that our engineers and other technical advisers, as also the managers and other senior members of the staff of the mines under our control, are subscribers to and think highly of the Journal. We believe that the paper has a wide circulation amongst all classes of the community, and the fact that we use it for the publication of the Reports and Accounts both of this Corporation and of the subsidiary companies of our Group, and also for the advertisement of commercial concerns in which we are interested, is evidence of our belief in the value of the Journal as an advertising medium.—GENERAL MINING & FINANCE CORPORATION, LIMITED.

GEORG. ALBU, Chairman and Managing Director.

Rand Mining in Picture



ROBINSON DEEP GOLD MINING COMPANY, LIMITED.

FARRAR BROS.

P.O. Box 305,
JOHANNESBURG.

4TH OCTOBER, 1910.

TO ALL WHOM IT MAY CONCERN.

The "South African Mining Journal," to which we have subscribed for the past twenty years, is an organ in which we place the highest confidence. The Journal has, throughout its life, aimed at the advancement and betterment of mining in this country, and its advocacy has undoubtedly contributed largely to the improvements effected in mining methods during recent years. It is read by practically everyone connected with the Mining Industry in South Africa, either directly or indirectly; and in our opinion it is, as an advertising medium, without a superior in the mining world of South Africa.

FARRAR BROS.

A. BAILEY,
P. O. BOX 50.
TELEPHONE NO. 1307.
TELEGRAPHIC ADDRESS:
"CORINTHIAN."

JOHANNESBURG,
TRANSVAAL.

13TH NOVEMBER, 1911.

THE EDITOR, "SOUTH AFRICAN MINING JOURNAL," JOHANNESBURG.

DEAR SIR,—It is pleasing to record my appreciation of the manner in which your paper is kept up to date and the reliable information which is found therein. So much so do we recognise this that a full file of your paper has been kept in this office for years as a reference both for mining news and statistics and for advertisements as to the suppliers of various kinds of machinery and mining requirements.—Yours faithfully,

ABE BAILEY.

THE ANGLO-FRENCH EXPLORATION COMPANY, LIMITED,
SIMMONDS STREET,
JOHANNESBURG.

30TH OCTOBER, 1912.

THE PROPRIETOR, "SOUTH AFRICAN MINING JOURNAL," JOHANNESBURG.

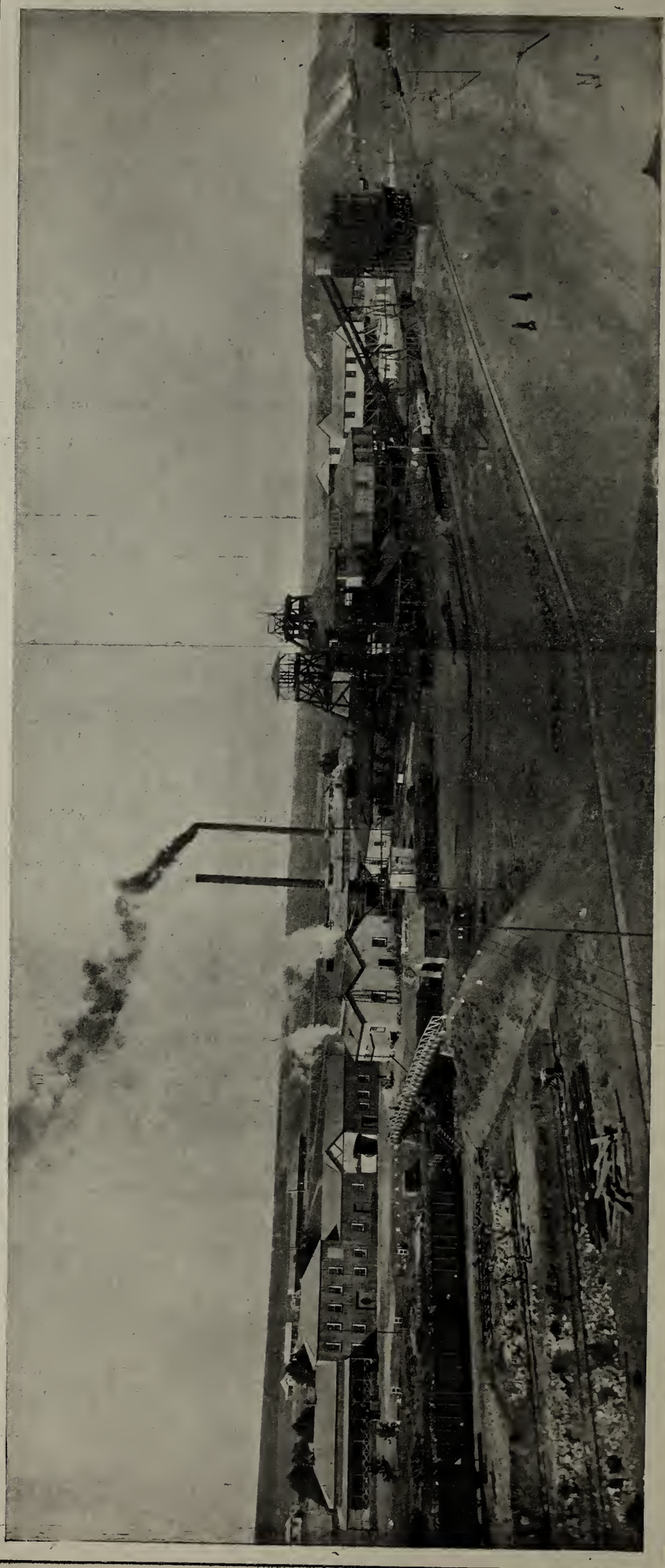
DEAR SIR,—I have much pleasure in stating that for the last twenty years I have watched with interest the growth of the "South African Mining Journal." The paper has always devoted itself to South African Mining and the industries associated therewith, and has, I believe, a large circulation among all classes of the mining community in this country.

The weight of its influence has always been thrown on the side of advancement and progress, and its reputation as a reliable journal on subjects affecting the South African Mining world is quite exceptional.

With the special facilities it thus affords advertisers of getting in direct communication with mining consumers of all sorts, I consider that it is second to none as an advertising medium for mining materials, etc.—I am, dear Sir, yours faithfully,

W. DALRYMPLE, Managing Director.

Transvaal Coal Mining in Picture



WITBANK COLLIERY, WITBANK.

Mining Men and the "South African Mining Journal"

More Letters of Appreciation :: Rand Financial Magnates, Engineers and Mine Managers pay high tributes to the Paper :: A Chorus of Praise :: Congratulations and good wishes from all quarters on our "Majority"

THE following letters have reached us since our intention to produce a special Majority Number was made known. They place on record the high opinion of the "South African Mining Journal" held by representative mining men. Many of them express regret for inability to contribute at greater length to this issue. We leave them to speak for themselves.

* * * *

Sir Sigmund Neumann's Words of Praise.

THE EDITOR, "THE SOUTH AFRICAN MINING JOURNAL."

DEAR SIR,—I have great pleasure in joining heartily in the numerous congratulations which you will doubtless receive on the occasion of your excellent journal having reached its majority.

From the early days of the Witwatersrand to the present time "The South African Mining Journal" has undoubtedly filled a most useful rôle, not only in keeping well posted in current news all those interested in South African mining, but in consistently striving for a high standard of efficiency. The Witwatersrand gold field occupies a unique and unrivalled position amongst the gold-producing areas of the past and the present, both as regards its enormous output of gold and the technical skill required to obtain that output.

It is largely owing to the freedom with which every technical suggestion or advance has been discussed in the various societies and in the press that this high degree of efficiency has been attained, and that the industry is still in the front rank of the mining world in its desire to adopt every possible technical improvement that may be brought to its notice.

There are undoubtedly many technical problems, especially in the direction of labour-saving appliances, which yet remain to be solved, but I am confident that the resource and determination which the industry has shown in overcoming one by one the difficulties of the past will not fail to find an adequate solution of these, or any other problems which may present themselves in the future. It is in this direction that your widely-read journal has rendered yeoman service to the industry by the collection and analysis of the mass of technical information which is continually being issued, and, by continuing to act as a medium of public discussion of the various problems, which present themselves from time to time, you will greatly help towards their satisfactory solution.

The interests of your journal are so bound up with the growth and prosperity of the mining industry of South Africa that, with the prosperity of that industry, I am confident your journal will continue the useful and prosperous career which I, in common with your many friends, desire for it.—I am, dear sir, yours very truly,

S. NEUMANN.

Salisbury House, London Wall, London, E.C.,
January 24th, 1912.

Mr. S. B. Joel's Good Wishes.

THE EDITOR, "THE SOUTH AFRICAN MINING JOURNAL."

DEAR SIR,—On the occasion of your twenty-first anniversary, I have much pleasure in congratulating you on the continued success of your "Journal," which is well deserved, owing to the able manner in which all technical matters and economic problems are dealt with. Wishing you and your paper all success in the future, I remain, yours sincerely,

S. B. JOEL.

10 and 11, Austin Friars, Throgmorton Street,
London, E.C., December 1st, 1911.

Lord Harris on Rand Vicissitudes.

THE EDITOR, "THE SOUTH AFRICAN MINING JOURNAL."

DEAR SIR,—In reply to your letter, you are very welcome to the following few remarks. You refer to my "long association with South Africa"; of course it is nothing like as long as that of many others who are connected with the mining industry of the country, but I might very easily have had a very much earlier association with South Africa. I was offered the office of High Commissioner and Governor by Lord Knutsford in 1888-89, and but for Lady Harris' delicate health at the time should most certainly have accepted it. It seems as if fate had intended me to be brought into relations with Cecil Rhodes. In Sir Lewis Michell's "Life" will be found a letter that he wrote to me about the Bechuanaland Expedition when I was at the India Office in 1885, a subject to which I was unable to attend, as my thoughts were all occupied at the moment with Indian affairs; then again, as I have already said, I was nearly brought into relations with him in 1889, and in 1896 I was elected to the board of the Consolidated Gold Fields, after which I, of course, was in the closest relations with him.

The general impression left upon my mind of my sixteen years' connection with South Africa is that it has been one long struggle against adverse circumstances. The Raid, of course, occurred before I joined this company, but following upon that were all the difficulties of financing the deep levels, the death of our chairman, Mr. H. E. M. Davies, the war, the struggle for Chinese labour, the struggle to prevent the Chinese being sent back, the struggle for sufficient labour ever since. Of course, there have been bright interludes, and one lives in hopes of a repetition of them. One, however, may be well content to feel that, notwithstanding all these difficulties, South Africa has steadily progressed and may confidently look forward to a steady advance in the future.—Believe me, yours faithfully,

HARRIS.

8, Old Jewry, London, E.C.,
February 16th, 1912.

Mr. Hennen Jennings on the Rand's Growth.

THE EDITOR, "THE SOUTH AFRICAN MINING JOURNAL."

DEAR SIR,—I very much appreciate the letter I received from you some time ago under date of November 1st, and I also realise and appreciate the compliment you extend me in asking me for an article for your twenty-first anniversary of the founding of your "Journal." I have been recently quite under the weather, and am taking shortly a trip to Europe, and I am now away from all my records and papers in Washington. I regret, with the time at my disposal, that I will not be able to attempt an article for such an occasion. I also have been of late years out of mining practice, and thus am rusty on writing on such a subject. I have, however, watched with much interest the growth of the industry on the Rand and appreciate the magnitude and greatness of the work done since my departure.—Yours very sincerely,

HENNEN JENNINGS.

15, Broad Street, New York.
January 9th, 1912.

Mr. W. H. Dawe's Congratulations.

THE EDITOR, "THE SOUTH AFRICAN MINING JOURNAL."

DEAR SIR,—In reply to your letter informing me that you intend to issue a Special Number of your "Journal" in May next, to mark the twenty-first anniversary of its foundation, needless to say, I wish you every success with the undertaking, and take this opportunity to offer sincere congratulations on the fact that the "Journal" has reached its twenty-first anniversary.—Faithfully yours,

W. H. DAWE.

Johannesburg, Transvaal,
March 15th, 1912.

A Rhodesian Appreciation.

THE EDITOR, 'THE SOUTH AFRICAN MINING JOURNAL."

DEAR SIR,—I take the opportunity of congratulating you on the approaching twenty-first anniversary, and of complimenting you on the success your paper has attained.—Yours faithfully,

HY. EWER JONES.

Rhodesia Exploration and Development Co., Ltd.,
Bulawayo, Rhodesia, February 25th, 1912.

A Tribute from Nigel.

THE EDITOR, "THE SOUTH AFRICAN MINING JOURNAL."

DEAR SIR,—In reply to your letter of the 7th inst., I do not think I can add anything to the "Mining Journal" that has not been already in that "Journal." Its intimate knowledge of the industry for so many years has rightly given it an authority not enjoyed by any other paper or journal.—I remain, yours faithfully,

ROBT. CURNOW,
Manager, The Nigel.

Nigel, Transvaal, February 28th, 1912.

Congratulations from the "Mining Magazine."

THE EDITOR, "THE SOUTH AFRICAN MINING JOURNAL."

DEAR SIR,—We extend our congratulations on this important occasion and wish the "South African Mining Journal" additional prosperity in the coming years.—Yours very truly,

"THE MINING MAGAZINE."
EDGAR RICKARD,
Business Manager.

819, Salisbury House, London, E.C.,
March 20th, 1912.

"Your Esteemed Journal."

THE EDITOR, "THE SOUTH AFRICAN MINING JOURNAL."

DEAR SIR,—I much regret that time does not allow me to write something for your esteemed journal. With best wishes.—Yours faithfully,

S. J. TRUSCOTT.

27, Austin Friars, London, E.C.,
March 15th, 1912.

M. George Rouillot Sends Remembrances.

THE EDITOR, "THE SOUTH AFRICAN MINING JOURNAL."

DEAR SIR,—I have been travelling a good deal lately and therefore your letter of January reached me only recently. I would gladly have contributed something towards the publication of your Special Number, but time at my disposal is now too short to write an article on so important a subject as you mention, which would require to be well thought over, figures and statistics carefully checked, etc. I therefore regret not to be able to respond to your kind suggestion, but take this opportunity to send you and all my old friends in Johannesburg my best remembrances and wish you every success with your publication.—I remain, yours faithfully,

G. ROUILLOT.

37bis, Rue de Villejust, Paris,
March 8th, 1912.

A Line from Mr. W. W. Mein.

THE EDITOR, 'THE SOUTH AFRICAN MINING JOURNAL."

DEAR SIR,—I have just received your invitation to prepare an article for publication in your anniversary number, and regret I am unable to respond on account of the time element. I shall look forward to the receipt of your annual because South Africa is always close to my heart, and particularly the mines, so that I am keenly interested in both.

I am trying to get this mine in good going order, and I feel I have succeeded. Everything indicates low cost of production compatible with maximum profit. After being two years away from South Africa, it is difficult to keep in detailed touch with the conditions of the mines, and I would not care to venture my opinion on how Rand costs could be lowered, and in consequence profits enhanced, at this long range.—Wishing your journal every success, I am, yours sincerely,

W. W. MEIN.

The Dome Mines Company, Ltd.,
South Porcupine, Ontario, March 18th, 1912.

Praise from Mr. John Hays Hammond.

THE EDITOR, "THE SOUTH AFRICAN MINING JOURNAL."

DEAR SIR,—Your letter of January 8th is received only now on my return from Mexico. I regret that I cannot give you the article to which you refer, because I am entirely out of touch with recent mining developments on the Rand, and it would be considered presumption on my part were I to express my views under the circumstances. While I am out of touch with the physical situation in the Transvaal, I nevertheless endeavour to keep informed as to other matters, because I have not lost any of my interest in the welfare of the country in spite of my long absence. I remember with much gratitude the valuable service the "Journal" rendered during the legitimate development of the mining industry during the time that I was in South Africa.—With best wishes, believe me, yours sincerely,

JOHN HAYS HAMMOND.

71, Broadway, New York,
March 15th, 1912.

Mr. E. P. Rathbone's Regrets.

THE EDITOR, "THE SOUTH AFRICAN MINING JOURNAL."

DEAR SIR,—Thanks for yours re Special Number of "The South African Mining Journal." I should much like to contribute some article to it, but am now so completely out of touch with South African mining news or anything which could in the least interest your readers about the early days, which has not already appeared in its columns, that I am afraid I could not send you anything that would interest your readers. I always see the "Journal" at the Mining and Metallurgical Institute, and read its contents through with great interest, and often wish that I could be back amongst you all again. I shall look forward with great interest to the production of the Special Number, and hope it will prove a great success in every way.—Believe me, as always, yours very sincerely,

EDGAR P. RATHBONE.

24, Estcourt Road, Wandsworth Common, S.W.,
November 28th, 1911.

Mr. H. Stuart Martin's Interest.

THE EDITOR, "THE SOUTH AFRICAN MINING JOURNAL."

DEAR SIR,—Many thanks for your letter of 3rd instant. I much appreciate your invitation to contribute an article for the forthcoming twenty-first anniversary issue of your "Journal." I regret, however, that, owing to my early departure for the Old Country, it will not be possible for me to prepare a paper, such as I would like, for inclusion in the special issue. Whilst unable to contribute in the above manner, I shall still look forward with keen interest to the publication of your anniversary issue, knowing full well that it will come up to your most sanguine expectations.—Again thanking you, I am, yours very truly,

HY. STUART MARTIN.

Rand Mines, Ltd., P.O. Box 1056, Johannesburg,
February 13th, 1912.

Mr. Palmer Carter's Appreciation.

THE EDITOR, "THE SOUTH AFRICAN MINING JOURNAL."

DEAR SIR,—In reply to your request for a contribution to your "Journal" for its twenty-first anniversary number, I have great pleasure in sending you these few lines of commendation as to the excellent work you are doing in publishing a journal which is just what this great mining industry needs. I have been a constant reader of your "Journal" for the past seventeen years, and I have watched with great interest the steady improvement you have made during this time. Undoubtedly such a publication as yours can do, and is doing, much to benefit the great industry which is the mainstay of South Africa. By constant attention to and agitation on the main points of importance connected with the mining industry, your "Journal" is doing a great deal to concentrate the attention of those connected with mining on the important questions that have to be dealt with. Undoubtedly one of the most important is the prevention of dust underground, and the only practical method of doing this is by the free use of water in all places where there is any dust. One of the chief difficulties has been to get the miners themselves to realise the importance of this point. That they are beginning to realise this is undoubtedly so. The Report of the Phthisis Commission has brought the whole question most forcibly before us. The line we have to work on is to realise that water alone is the great cure for the dust evil underground, and to see that all dust is absolutely prevented in a mine. Your "Journal" certainly realises this, and I can only commend you in the good work you are doing in this line.

I send you every good wish for your further success and the hope that your "Journal" will always be the leading organ of South Africa's mainstay.

PALMER CARTER,
Manager.

Robinson Gold Mining Company, Ltd.,
P.O. Box 1024, Johannesburg, May 6th, 1912.

Mr. H. H. Webb describes the Journal as "Part and Parcel of the Rand."

THE EDITOR, "THE SOUTH AFRICAN MINING JOURNAL."

DEAR SIR,—I have just returned from a long trip in the western part of America, and find your letter of January 29th awaiting me. I shall look forward with great interest to the publication of your "coming of age" number, as the "South African Mining Journal," having grown up with the industry, has become, through its many interesting and valuable articles during the last twenty-one years, one might say, part and parcel of the Rand itself. I have found each issue containing something of interest to me; particularly is this true when one who has been associated with mining on the Rand for a number of years finds himself at a distance from his former field of operations. I regret exceedingly that I have not been able to find time to contribute to your Special Number, but my movements and duties render this particularly difficult at the present time.—Kindest regards. Yours sincerely,

H. H. WEBB.

The Gold Fields American Development Company, Ltd.,
71, Broadway, New York, March 14th, 1912.

Mr. L. Reyersbach's Optimism.

THE EDITOR, "THE SOUTH AFRICAN MINING JOURNAL."

DEAR SIR,—I regret that want of time prevents me contributing to your proposed special issue. My views on the mining industry in South Africa generally are, however, so well known that reiteration is really not necessary. Notwithstanding the strenuous times we have passed through, and are still passing through, I retain the utmost confidence in the future of the mining industry, and feel confident that it will emerge successfully from the trials of the last few years. Wishing you and your "Journal" every success.—Believe me, yours very truly,

L. REYERSBACH.

1, London Wall Buildings, London, E.C.,
March 14th, 1912.

"Time Not Ripe."

THE EDITOR, "THE SOUTH AFRICAN MINING JOURNAL."

DEAR SIR,—Mr. Stuart Martin thanks you for your courtesy in asking him to provide a paper on current topics within his sphere, but, as he rightly explains to me, the ideas and improvements for which he is responsible are still largely in the making, and it is very much better that he should defer any public announcements until such time as his results can be given in definite figures of comparison. Wishing you every success on attaining your "majority," I am, yours sincerely,

HUGH F. MARRIOTT.

1, London Wall Buildings, London, E.C.,
April 26th, 1912.

Mr. Ross E. Browne Pays a Compliment.

THE EDITOR, 'THE SOUTH AFRICAN MINING JOURNAL."

DEAR SIR,—I shall look forward to the receipt of your anniversary number with much interest—in fact, I always look forward with pleasure to the receipt of your journal from week to week. You manage to make it particularly interesting to the engineer. I notice that the total gold production of the Rand to date—during twenty-seven years—is now greater than the total of California (about £300,000,000) during sixty-three years. This is a remarkable showing for so small an area as that of the Rand. There has been nothing to compare with it in the world's history of gold-mining. I am sorry to see your working costs going up again, and hope it is not due to relaxation of effort.—Yours faithfully,

ROSS E. BROWNE.

RAND MINING IN PICTURE



Views of the Roodepoort United Main Reef Gold Mining Company

Metallurgical Book-keeping

How the Rand may Profit from following the Example set by American Smelting Works

By SIDNEY J. JENNINGS
(Formerly Consulting Engineer to Messrs. H. Eckstein & Co.)

SOME of the recent happenings on the Rand have emphasised the fact that the methods of reporting the gold output, heretofore considered adequate, break down when employed on the large scale necessitated by the size of the larger companies. When the gold mining companies had an average crushing capacity of less than five hundred tons a day, and the recovery value averaged over thirty-four shillings per ton, the actual amount of gold tied up in process of being dissolved or precipitated and the proportion this amount bore to the total output was so small that it could be neglected in the monthly reports without throwing the metallurgical bookkeeping too much out of gear. With the increase of the size of plants, with the addition of new processes which extend the time the ore is under treatment, the total amount of gold locked up in the process of treatment is large, and with the decrease in the average value of the ore treated the percentage that this amount bears to the monthly output is likewise increased.

With these changed conditions, phrases like "absorbed in the plant," which were formerly used and which sufficiently covered this deferred asset, no longer seem adequate, and a new term necessitating a closer approximation to the facts of the case seems called for.

The smelting works of America buy all metal-bearing material at definite rates based on the assay value. Payment is made on a definite date after the receipt of the material. This interval varies from forty-five days to one hundred and five days. In many cases it takes more than six months from the time the ore is received until the metals it contains are in a form that can be sold. It is apparent from such a state of things that, in order to keep the monthly statement of metal output correct, an account must be kept of the metals undergoing treatment.

In the group of smelters with which I am now connected, the values of the metals undergoing treatment are segregated under the heading "Metals in Process." I suggest that the companies on the Rand use the phrase: "Gold in Process" to similarly include the values of the gold in the partially treated ore, the circulating cyanide solutions, the undissolved zinc, slags, and other by-products.

If this suggestion were adopted, it would necessitate the knowledge on clean-up day of the weight and value of the ore in the tanks; of the weight and gold contents of all cyanide solutions in the plant; of the weight and gold contents of the undissolved zinc returned to the cyanide boxes; and of the weight and assay value of all slags and by-products. This knowledge, together with the knowledge of the weights and value of the ore crushed and the tailings discharged during the month would enable the metallurgical balance sheet to be constructed with a fair amount of accuracy. There would be undoubtedly "unaccounted for losses" due primarily to errors in the estimate of tonnages passed through the plant and in the sampling of the various products. There would be also a small amount of absorption of gold in the various tanks, launders, boxes, sumps, etc., composing the plant, but this quantity would become decreasingly negligible with the saturation of the plant.

My experience has been that these 'unaccounted for losses" become very small with the increased precision of the metallurgical bookkeeping, which causes a pro rata increased energy on the part of the staff in ferretting out all losses. I feel convinced that the adoption of the methods necessitated by the use of the suggested term will not prove unduly burdensome to the staffs of the gold mining companies of the Rand, and will inevitably tend to a closer study of the present losses and a possibility of the elimination of some of them. Its use would also tend to a renewed confidence in the declaration of the outputs of the gold mining companies of the Rand, a confidence which has been somewhat rudely shaken by the happenings of the past year.

RAND MINING IN PICTURE



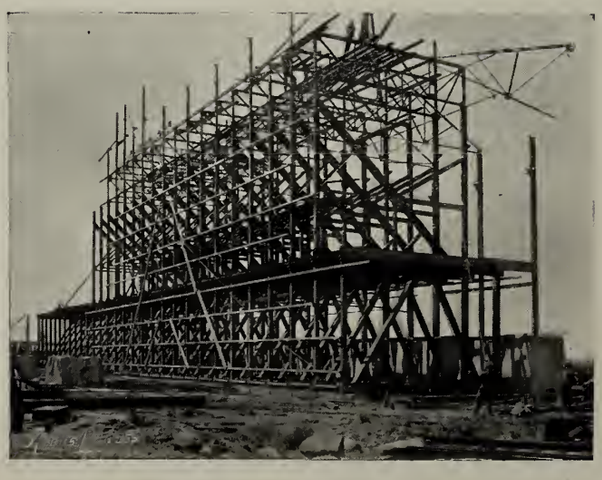
Crown Mines Trestle-way to New Mine

Rand Mining in Picture

JOHANNESBURG CONSOLIDATED INVESTMENT GROUP



Consolidated Building (Barnato Group Offices), Johannesburg



Consolidated Langlaagte Mill under Construction



Consolidated Langlaagte Sand Collecting Plant

What South Africa Owes to the Mining Industry

A History and Review of how the Country has been built up on the Gold and Diamond Mines

By Sir DAVID HARRIS, K.C.M.G., D.S.O., V.D.

A LITTLE over forty years ago there was practically no mining in operation in South Africa. Before this period South Africa was a poor country, the large majority of its inhabitants were struggling for a mere existance, and there were not more than fifty miles of railway in the four colonies—the Cape, Natal, Transvaal, and the Free State. To-day there are 7,548 miles of railway owned by the Union, 561 miles under construction, and a further 400 miles sanctioned for construction. Our imports have to-day reached the big figure of £38,035,495, while our exports amount to the colossal sum of £57,308,214. The exports from mining, an industry that did not exist forty-five years ago, stood last year at £45,000,000, against a total value of produce exported from the Union of £13,678,000.

This country has been made wealthy and its people have prospered by reason of the working of the mines. The ante-mining period was from 1859 to 1869. In 1859 the total revenue of Cape Colony was £506,000. Giving the agricultural period a life of ten years, in 1869 the revenue of the Cape was £580,000—an increase of £74,000 in ten years. In 1859 the exports were £2,021,000, and in 1869 they were £2,225,000—an increase of £204,000 only in ten years. The financial affairs were almost at a standstill during that agricultural period.

When I landed at Capetown in 1871 there was only one line of railway—from Capetown to Wellington, and Durban was a village. I remember it took two spans of oxen to draw a loaded wagon through what are now the principal streets of Durban. That was the state of things before the mining period. Now take what I term the first diamond mining period. In 1879-80 the revenue of Cape Colony was £2,522,000, an increase in ten years of £1,942,000—or nearly four times what it was at the end of the exclusively agricultural period. The exports, including specie, in 1879-80 were £6,385,000, an increase for the ten years of £4,116,000, or nearly 200 per cent.

Now take the second mining period, the second diamond mining period, from 1879 to 1887—eight years. To take a period of ten years in this case would be to encroach upon what I term the first gold mining period. The total gold exported in 1887 was only £92,000—hardly worth considering in this connection. In 1887 the revenue was £3,159,000—an increase in eight years of £637,000. The exports, including specie, were £7,850,000 in 1887, an increase of £1,473,000. When the diamond industry was fairly established there was not a very great increase in the figures, which indicate the progress and prosperity of the Colony, as is evidenced by these figures of the exports and revenue.

Now take the first gold mining period, which I put from 1887 to 1898—eleven years, so as not to take into account the years of the war, which were absolutely unusual. In 1898 the revenue was £6,317,000, an increase in the eleven years of £3,158,000, or of 100 per cent., which, I hold, is due to the development of mining in the Transvaal. The exports, including specie, were £24,430,000—an increase of £16,565,000.

Take the bank deposits. In 1869, at the end of the agricultural period, the fixed deposits in the Cape Colony were £724,000, and the floating deposits £1,034,000, a total of £1,758,000. In 1879 the fixed deposits were £3,672,000, and the floating deposits £2,458,000, a total of £6,130,000. In 1887 the fixed deposits were £3,122,000, and the floating deposits £2,827,000; there was in the Post Office Savings Bank, which came into operation about then, £266,000, giving a total of £6,215,000. In 1898 the fixed deposits were £3,731,000, and the floating deposits £4,407,000, and there was in the Post Office Savings Bank £1,736,000, giving a total of £8,847,000, or an increase in the first gold mining period of about 250 per cent. The second period was about stationary, and in the third, or first gold mining period, there was an increase of £2,659,000.

In 1865, and that is as far back as I can go, the total income of the Capetown Municipality was £21,819. In 1909 the total revenue of the Capetown Municipality was £346,856. In 1886 the total assessed value of Divisional Council property in the Cape Colony was £36,751,969; in 1909 the total assessed value of Divisional property was £92,347,644—an increase of £55,000,000 since the gold mining industry in the Transvaal made itself felt throughout South Africa.

I have necessarily dealt chiefly with the Cape in these figures, but it will be at once apparent that other Provinces have benefited in the same proportion from the development of mining in this country.

A phase of mining that is apt to be overlooked is the fact—a most important, though I am afraid scarcely realised, one—that a large proportion of the value of the gold and diamonds extracted from the various mines each year remains in the country in the form of wages, railway rates, purchase of fuel, agricultural produce, etc. Take the latest period for which the figures are available. The total mineral production for 1911 was of the value of £47,087,000. For that production £20,519,984 was paid out in wages, and £14,070,291 in the purchase of stores—together £34,590,275. Deducting from that total £2,500,000 for the cost of machinery purchased in Europe, leaves £32,000,000 circulated in the Union—money actually spent in the Union during that year. I estimate the value of diamonds still to be extracted from existing mines at £250,000,000, and the value of gold still to be extracted from existing mines may be put, so far as I can ascertain it, at £1,000,000,000. Remembering these figures it is not difficult to comprehend what an enormous influence mining will have upon the development of the country from mines being worked to-day, without regard to new discoveries.

Rand Mining in Picture

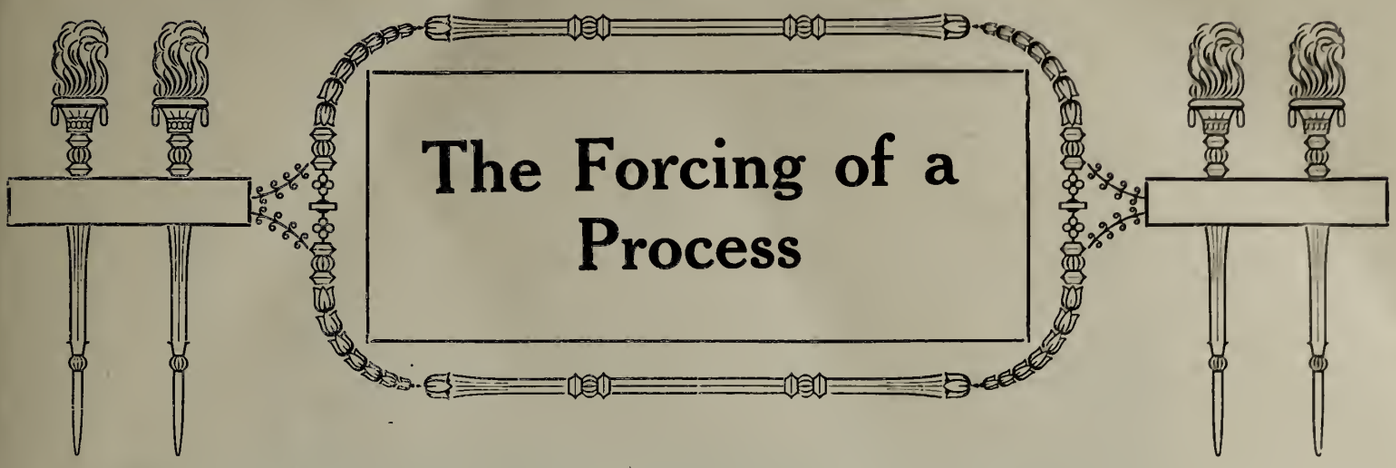
JOHANNESBURG CONSOLIDATED INVESTMENT GROUP *(Continued).*



Consolidated Langlaagte Crusher and Sorting Station



No. 3 Shaft, State Mines, Modderfontein



The Forcing of a Process

History and Review of the Advent of the Cyanide Process that Revolutionised Gold Mining

By ALFRED JAMES

ONE is apt to regard the inventor or owner of a successful method or process as a lucky man, but history shows that the royalties derived from even the greatest epoch-making invention are usually but small recompense for the ingenuity, skill, patience, investigation, determination, cheery optimism, work, and capital expended in bringing the invention to a successful issue, and in, what is still more, forcing its adoption on a public which generally requires some years of education as to the advantages to be gained Hence it generally happens that the fourteen years' protection on an epoch-making invention covers little more than the period of incubation, nursing, and developing to adolescent capacity.

Possibly the epoch-making inventions of the day are propulsion of vessels by steam turbines, and radio telegraphy. To take the first. After fourteen years of incessant effort and skilful striving Parsons found himself at the end of his patent life with little more than his expenses. The history of Marconi is widely known. After all these years of ceaseless ingenuity and untiring brilliant inventions the capitalists financing Marconi do not appear to have received, up to December, 1911, a single penny on their money invested. Now, I understand, a dividend of 1½d. on each pound share is at last in sight.

But apart from the smallness of the remuneration there is another feature that stands out strongly: that but for the invincible enthusiasm and dogged determination of the inventor every improvement would be the failure in practice it is first almost universally pronounced to be by those learned in the art. It is, therefore, of the utmost value to the industry that the connection of the inventor with the working of his invention should be obtained, maintained, and encouraged.

I intend in this paper to deal with what is now a matter of history, viz., the forcing on the industry of the cyanide process. One has to go back to 1886 to appreciate the courage, indomitable perseverance, business keenness, and effort of the parties mainly responsible, viz., Messrs. Wright, Verel, and Gow, of the Cassel G.E. Company. In that year this company found itself faced with the sudden disappearance of inventor and secretary and the collapse of a process which could not be made to work. The board, undeterred by the flight of the inventor, determined to make it work themselves. It was discovered that the electric leads had been cut and the ends hidden; this was speedily set right and the equipment restarted. It was found that the process, instead of being a cheap method of gold extraction, was in reality an expensive way of producing bleaching powder by the electrolysis of salt solution to which lime was from time to time added. At this time Mr. J. S. MacArthur wrote an article to the technical Press showing how the process should be worked. The board therefore secured Mr. MacArthur's services, which resulted, however, in no improvement in results. MacArthur, however, brought forward a little thing of his own, the extraction of gold from ore by solutions of ferric chloride. But this method proved infeasible in practice.

Still undeterred and anxious to press forward the process, the board next investigated MacArthur's proposition of the use of solutions of cyanide of potassium, and now, with success apparently at hand, fresh difficulties and worries arose, only overcome by a display of such enthusiasm and bravery as but few men have shown under similar conditions either before or since. The board had already despatched an unsuccessful expedition, consisting of Messrs. Feldtmann and Arthur, to the St. John del Rey Company to fulfil a contract entered into for the old process, and, undismayed by the lack of result, resolved on sending out a number of expeditions to introduce the cyanide process and to educate the mining community to an appreciation of its advantages. The first expedition (Messrs. McIntyre) was sent to Queensland, the next to New Zealand (Mr. McConnell). From these two expeditions but little tangible resulted, Messrs. McIntyre demonstrated on concentrates and pyritic ores in iron pans, and Mr. McConnell erected a successful ore treatment installation at Karangahake, but their work attracted no users except for Dr. Scheidel's small concentrates plant at the Sylvia (1890).

But the lack of success of these two expeditions from the point of view of forcing a process on an industry or gaining adherents in no way damped the ardour of the board. Before long a fresh expedition was planned to Africa (in the latter part of 1888), and a year later MacArthur was also sent off on an expedition to America. This latter expedition of MacArthur's was not a success; indeed, it was not until some years later, after the process was a great success in Africa and New Zealand, and Dr. Scheidel had proceeded from the latter territory to California, that the application of the process in Mexico and the success of cyaniding at Mercur compelled the attention of the mining interests of the United States.

It will thus be seen that of four expeditions one only, the African, was successful in gaining adherents, and even then a further expenditure of time, money, and energy was necessary to force the process into general use.

Rand Mining in Picture

JOHANNESBURG CONSOLIDATED INVESTMENT GROUP *(Continued)*



Consolidated Langlaagte Tube Mill Pit



Consolidated Langlaagte Mill under Construction

Let us look into the history of the African introduction. Details have never before been published, and a study of them will serve to show the enthusiasm, skill, courage, capital, and business energy necessary to convert even a successful demonstration into a general adoption. The African pioneer arrived in this country towards the end of 1888, and in accordance with his instructions at once proceeded to Lydenburg, Barberton, and the Horo mines in Swaziland, it being the intention of the board to demonstrate in either the first or last named district. Certain investigations were made by the pioneer which decided his future course of action, but his visit to Barberton and his investigations at the United Pioneer (Moodies) decided Mr. J. H. Cordner James to form a local syndicate at the outset, consisting of Messrs. J. M. Buckland, W. W. Webster, and himself, to acquire the African rights of the process. This step was the first real encouragement received by the keen and determined Scotsmen who had been so long pushing the process, and it undoubtedly was the cause of the subsequent demonstration being on so large and effective a scale.

From Barberton the pioneer came to the Rand, and after an examination underground, possible mainly owing to the extreme courtesy and kindness of the late Mr. Hermann Eckstein, of well nigh every mine of note in the district (over eighty), from the Nigel to Blaauwbank and Malmani, he settled down to conduct a series of experiments in an assay laboratory at Langlaagte Estate placed at his disposal, entirely without charge for laboratory, stores, or labour, by the liberality and shrewd foresight of Mr. (now Sir) J. B. Robinson. The investigations completed, the African pioneer returned to Scotland to consult with his board as to the offer made by the local syndicate to purchase the South African patents. This was accepted subject to the success of a public demonstration of the process to be held at Johannesburg, and the pioneer designed the necessary installation and brought it to Johannesburg early in 1890. Meanwhile, one of those worries which daunt the most enthusiastic inventor cropped up in the matter of patent rights. On his original arrival in Capetown the pioneer found that Dr. Wernher von Siemens (represented by Mr. E. Lippert) had a patent for a cyanide process, with electrical properties, dated only the month after the MacArthur-Forrest patent. Being very young and rather inexperienced, the pioneer did not deem it necessary to worry his board with such disquieting information, he merely decided on the spot to raise an action for the revocation of the Siemens' patent. That such an action had never before been brought in the Colony, and that his attorneys proved also to be the Siemens' attorneys, in no way disquieted him. His attorneys had to choose between the two clients and to proceed with the action. This step was most fateful to the future of the South African patents, for on his arrival at Pretoria he found that some local difference of opinion as to the difference between the Taal and High Dutch had caused the postponement of the acceptance of the MacArthur-Forrest application until a month after that of Siemens, who thus had prior rights in the Transvaal. Nothing daunted, the youthful pioneer raised a similar action—but with apparently less ground—at Pretoria to that commenced by him at Capetown, merely reporting to his board by letter as to the condition of affairs found by him and his consequent action.

The result is distinctly interesting; the Cape Courts decided in favour of MacArthur-Forrest, as the true and first inventors, and the Transvaal Court, although in this case Siemens had the prior date, decided to follow the decision of the Old Colony. The writer is informed that these were the two first patent actions in South Africa. On so little hung the fate of the introduction of the cyanide process into the Transvaal!

The demonstration plant, referred to previously, was so designed as to be suitable for agitation or for percolation, and it was erected by arrangement with the Salisbury Company at their battery, and the enthusiastic encouragement given to the process by the then manager, Mr. R. A. Michell, will be ever gratefully remembered by those who were naturally very appreciative of the slightest expression of approval in those early days. It is only fair to refer to the attitude of the Press and the value of the publicity and encouragement freely and cheerfully extended to the pioneer of the process. Dormer of the "Star," Rathbone of the 'Mining Journal," Piet Davis of Maritzburg were towers of strength in those days. They awoke the interest of the community, and, indeed, prepared the way for the subsequent adoption of the process. The writer has naturally much experience of the daily, the financial, and the technical Press in four of the five continents. Great publicity has been given at great length to his technical writings and to his work (whether he wished it or not), but never in all his professional career has he known of a single instance of payment for Press services so generously and spontaneously rendered. Indeed, in South Africa the efforts of the gentlemen mentioned were greater than would have been anticipated from a mere technical interest. The pioneers came to regard them as their champions, whose advice was welcomed and usually followed.

By April, 1890, the demonstration plant at the Salisbury was ready for action, and early in May Mr. MacArthur, whose presence it was considered would be of especial value at this juncture to the syndicate, arrived on these fields, and the demonstration took place, the pioneer having quietly run one hundred tons through the plant first so as to have the staff acquainted with their duties and the plant running smoothly.

The success of the demonstration is well known. Later, in 1895, Mr. Hennen Jennings reminded the writer that the results then being obtained at the Crown Reef were just those obtained by him and Mr. J. R. Williams in 1890 at the demonstration, but the fact remains that, except the manager (Mr. Michell) of the property on which the plant stood, not a single one adopted the process!

This should be well considered and taken to heart by all persons fathering a new process, as it is just one of the difficulties by which an invention is faced. Practically every-epoch-making invention is pronounced a failure at first, wherever exploited, and it is only the invaluable enthusiasm of the inventor and his financial associates which enables them to survive this blow and to ultimately force the process on the industry. The appositeness of this conclusion may be emphasised by a reference to what is now termed the success of the day here—the Butters-Cassel filter. It is undeniable that this filter, though a long-proved success in Australia and America, would not have survived its introduction at the Crown Mines but for the enthusiastic determination of the representatives of the company owning the filter and the skill and business foresight of a former user of the filter. Indeed, for some months after its start it was openly pronounced a failure, and even now it has been adopted by only one company on the Rand outside of the group in which it was introduced.

But to revert to the history of the cyanide process. The Gold Recovery Syndicate who had contracted to purchase the patent rights found themselves, in the latter half of 1890, with no backing and no adherent other than Mr. Michell, but for whom they would have had the demonstration plant left on their hands. Mr. MacArthur had returned to Scotland, taking with him his cheque in payment of the plant, and it was now left

Rand Mining in Picture

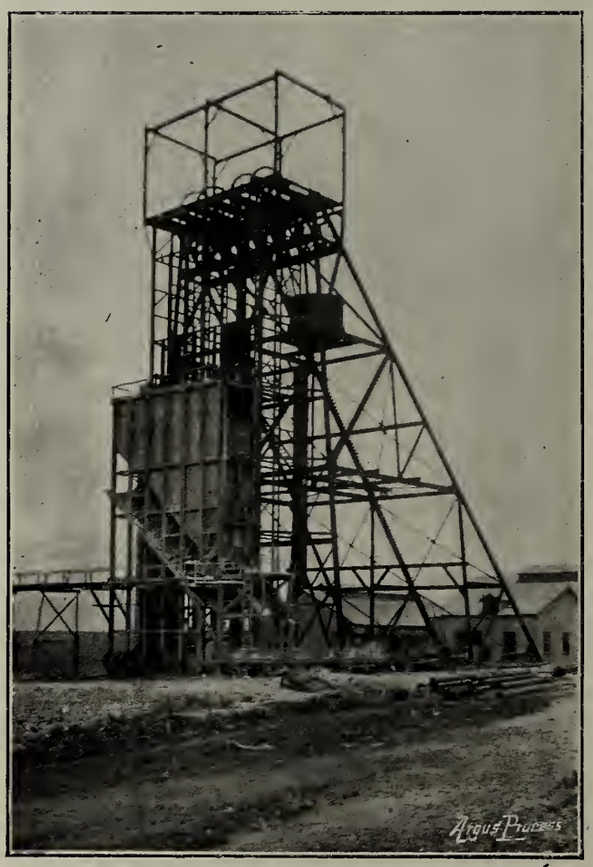
NEUMANN GROUP



Consolidated Main Reef and Main Reef West Joint Battery



Consolidated Main Reef-Main Reef West Joint Cyanide Plant



Consolidated Main Reef Deep Level Shaft



Main Reef West, West Shaft



40 Ton Ore Truck, Main Reef West

to the syndicate, with which was now associated the pioneer, to take other and still more vigorous measures to force the adoption of the process.

It was at this juncture that a Scotsman connected with one of the local banks came to their aid. Funds were obtained by which advantage could be taken of the liberal terms on which Hennen Jennings offered a block of valuable Robinson tailings, thereby enabling himself to obtain greater knowledge of the practical working of the process.

Up to this time the process had been described as for refractory ores and concentrates only. The demonstration was limited to the treatment of material of this nature. But advantage had been taken of the position of the works to treat tailings from the Salisbury, Meyer and Charlton, City and Suburban, and elsewhere by percolation with a strong solution of as low a strength as 0.225 per cent. KCy. It must be remembered that the chief objection of those days was to the time taken for treatment, usually three days, and so solutions were used of greater strength than in some of the work done in the laboratory at Glasgow. An installation was therefore designed by the pioneer for the treatment of tailings by percolation, the plant to be made by local men of material (9 inch × 3 inch deals) locally obtainable. A small water tank at the Salisbury was taken as a pattern, and the plant was designed with square vats (the original plant had round vats of Karri timber) of the then unheard of size of 20 feet × 18 feet 6 inches × 3 feet 9 inches. The plant was built by Messrs. Tarry in December, 1890, under the supervision of the writer, who laid down the plan of operations carried out by Messrs. Webster (manager), Gaze, and Darling. The plant did not meet with the approval of the authorities in Glasgow, who had sent out a plan of a small (8 feet × 6 feet (!)) square Tharsis tank as one to be followed, and it gave the writer no little satisfaction to be able to reply, to a letter prognosticating failure, with an account of the great success of the plant. Within two months of the commencement of operations the plant was showing a profit of over £2,000 a month on an original outlay of about £3,000, and the African Gold Recovery Company was formed and Mr. MacArthur was sent out by the new company to arrange for the local conduct of its operations.

But not even yet was the process forced on the industry. Fresh contracts for tailings treatment were entered into with other companies, such as the Crown Reef and the Meyer and Charlton, and then at last the companies decided to adopt the process, and the fight was won.

After five years' hard work, involving the training of many metallurgists, the erection of a cyanide manufacturing works to prevent the supply of cyanide to the mines being restricted, the despatch of six expeditions, the fighting of two law suits, and the carrying out of much chemical research, such as the use and effects of cyanide, alkalies, oxidisers, lead salts, alkaline sulphides, etc., the manufacture of cyanide by various processes, and the expenditure of over £100,000, an epoch-making process of the greatest success had been forced on an industry.

It is but a fair conclusion that but for the expenditure of so much dourness and determination, of so much patience and encouragement, of so much business commonsense and foresight, and last, but not least, of so much capital, the discovery of MacArthur and the Forrests, and of their financial associate, Morton, would not have been made available to the industry for many a year, but would have laid fallow as a non-pursued chimera with the unfollowed up ideas of Faraday, Bagration, or the more practical processes of Rae and Simpson.

And what of the reward offered by the industry as remuneration for so much enterprise, effort, and success; was it adequate? The decision of this question must be left to the industry; although the writer was so intimately associated with the patent owners, he has never in his writings felt free to challenge the actions of the South African mine owners, because he understands they offered to pay a royalty greater than that (2½ per cent.) which he had himself laid down and found so profitable in New Zealand. As to whether, after the result of the action taken by them—a result which, in view of the decision of the English Appeal Court, would have conceivably been different had the Transvaal been at that time a British Colony, with right of appeal to the Privy Council—the mine owners might have felt called on to make some remuneration to the patent owners who had so fostered the introduction of the process, one can understand that after the expense, worry, bitterness, and exhaustion of a prolonged fight, a feeling of relief at the result would predominate over all other feelings But surely it behoves the industry to see that the result of the challenging of the MacArthur-Forrest patent is but to deter other inventors from putting forward their methods in the Transvaal. Such a result might readily involve the Witwatersrand in an annual loss far greater than the royalty it would have paid had it not challenged the patent.

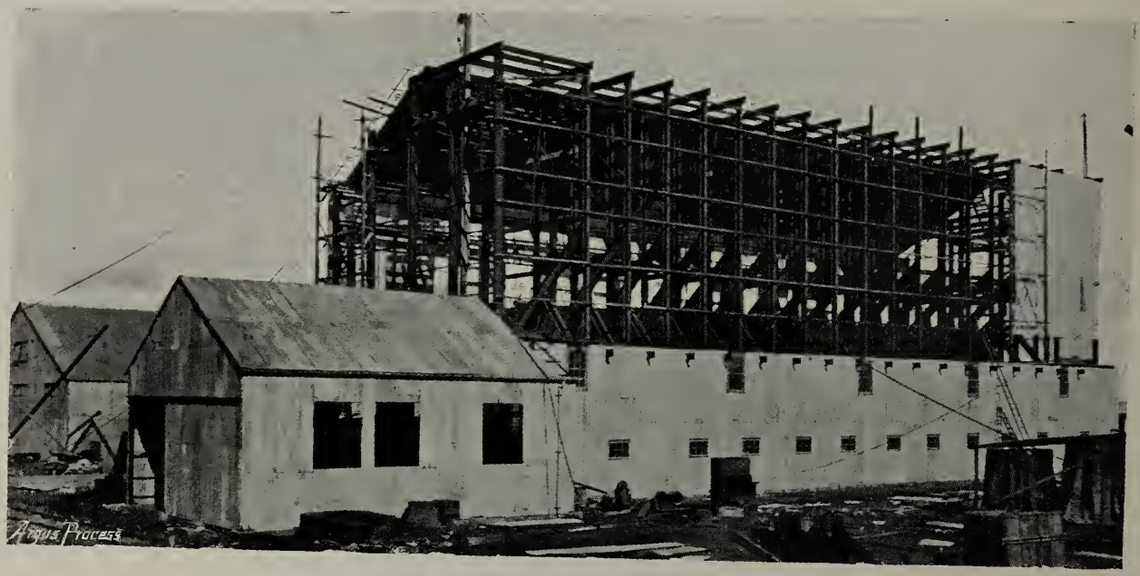
There is one other matter which arises from the consideration of the effect of the severing of the interest of the pioneer group in a new process. Those who have grown grey in the working of the new process—possibly in different groups—may feel that they have not the prospect of a retiring pension for their old age. Such a thing might have been relied on had a pioneer company still continued its ownership to the usual period of patent expiry. The greatest gold field in the world can be largehearted and will perhaps pardon a suggestion that a small contribution from the mines of a fraction of what they have saved in patent royalties would suffice to establish a fund, called, e.g., the Cyanide Pioneers' Pension Fund, from which all cyanide pioneers in charge of plants from, say, the earliest days of the process (first plants at each mine) who have continued in the industry, not necessarily as cyaniders (they may have since become managing directors, consulting metallurgists, reduction officers, samplers, or assayers) may, on their retiring after twenty years' service, become entitled to draw a pension of, say, £300 a year for life. As to whether recipients should show that they are not in receipt of an income greater than £300 a year from any other source is beyond the scope of my suggestion. The money for the fund might be secured in a somewhat different way. It has now been realised that the industry the world over has the free use of an apparatus which has stood the test of time and which is still used practically unaltered, but which was specially designed for the first tailings plant (the Robinson), and which could have been patented. Originally the gold was precipitated from the cyanide solution by zinc shavings placed in chloride of calcium tubes, subsequently earthenware pots were used for a similar purpose. For the Salisbury demonstration plant teak boxes of four compartments were designed by the pioneer, each compartment having a cast iron box, with perforated bottom, which could easily be withdrawn to facilitate the cleaning up operations for demonstration purposes. For the Robinson plant, however, a box of a novel type was specially designed; it had a series of compartments with a space for the inflowing solution, which was conducted by a baffle to the bottom of a large compartment in which was placed an easily removable tray on which the zinc shavings rested, and up through which the gold solution percolated, with a downward movement through baffle channels only. At the bottom of each compartment was a space for gold precipate, and connected to the bottom of each compartment was a pipe, or channel, for drainage and cleaning-up purposes. The

Rand Mining in Picture

CONSOLIDATED MINES SELECTION GROUP



Headgear, Brakpan Mines



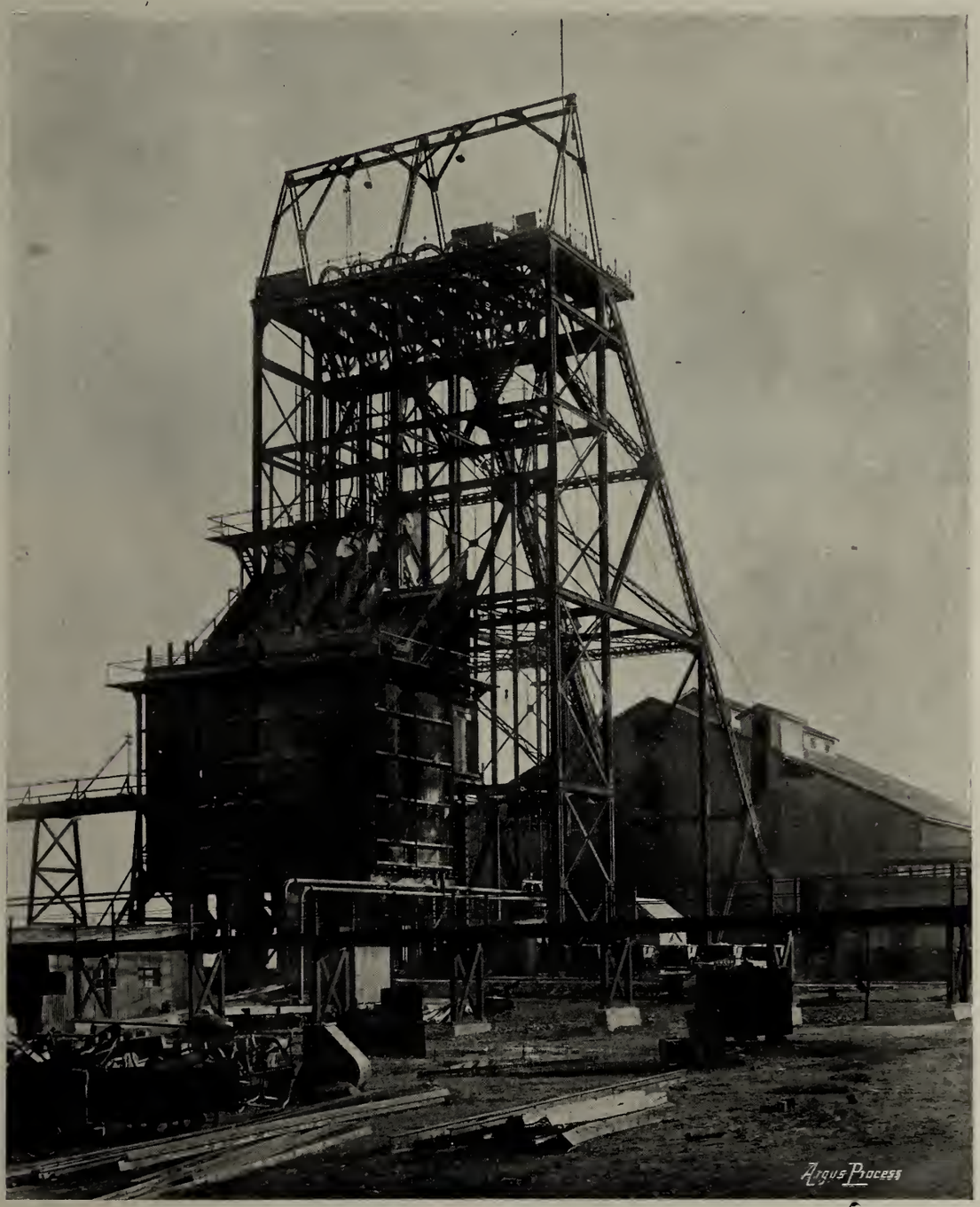
Brakpan Mill under Construction



Springs Mine, South Headgear

box, except that it is now frequently used in steel, is still well-nigh universally adopted for the recovery of the precious metal A royalty of £20 a box—such as is freely given for a cone or tube mill feeder—would probably not have been considered at all excessive. Probably ten thousand of such boxes have since been used on the Witwatersrand alone; a small gratuity or recognition per box placed to the credit of a cyanide pioneers' fund should suffice to make comfortable for the end of their lives those pioneers (first men on first plants of mines only) who may find themselves now seeking rest after their twenty years' toil.

RAND MINING IN PICTURE—CENTRAL MINING GROUP



Turf Mines Shaft of Village Deep, Ltd.

Rand Mining in Picture

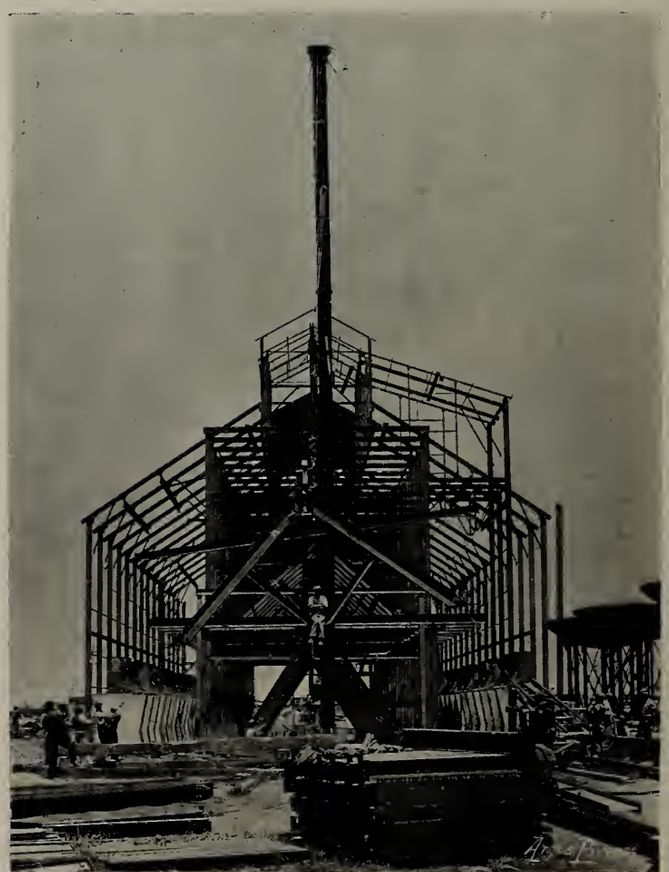
CONSOLIDATED MINES SELECTION GROUP *(Continued)*



Brakpan Mines, Ltd., showing Battery and Tube Mill Plant in course of construction



Brakpan Mines, The "Dip" Shaft



The Brakpan 160 Stamp Mill during the erection stage

Ore Valuation

Notes and Observations indicating in what circumstances the Methods usually employed on Rand may cause Over-valuation

By G. A. DENNY

THE subject of ore valuation naturally divides itself into two parts, namely: (1) The taking of the samples and their preparation for assay; (2) the methods employed for computing average assay values, average widths, and the tonnage contained in the sampled blocks of ore.

The Taking of the Sample.

The experience I have had in other countries since leaving the Rand has convinced me that the methods of sample taking at the Rand might be improved.

For catching the sample, the Rand sampler usually takes with him an iron panning dish, into which the pieces of reef matter fall as they are broken out. In place of this iron dish, I have used in this country a round, pliable basket, about eight inches deep and twelve inches in diameter, lined with strong oilcloth, which makes a far superior receptacle for catching the ore particles, because it easily fits into any corner or difficult place and does not allow the pieces of ore to escape by rebound, as the iron dish does. It is, however, only in places that preclude the use of canvas on the floor that I use a receptacle for catching the sample. I have found by experience that a better sample is obtained when all the sample broken out is caught on a piece of canvas spread so that everything must fall into it. The canvas should be about ten feet long by about six feet wide for use in the levels, and may be ten feet square for use in the stopes. The use of a canvas catcher tends to the taking of bigger samples, which alone is a great element in its favour. Rand practice would not, I believe, exceed the cutting of one to one and a quarter pounds of ore per foot of sample cut. My present practice is to take not less than five pounds per foot of sample cut, and often it reaches as high as ten pounds. The object of this is to lessen the possibility of salting, as large quantities are less easily salted than small, and also to lessen the danger of over valuation from inclusions of small specimen pieces of high grade ore.

In cases in which the sample is in excess of fifteen pounds weight, I reduce it by breaking down the whole sample, in the mine, to a gauge not exceeding three-quarter inch, thoroughly mixing and quartering the total bulk in the usual way until a suitable weight, say from five to seven pounds, remains to represent the sample. In the assay office the mine samples are subsequently all reduced to pass a quarter-inch mesh before being cut down, then halved in bulk by passing over a sample dividing device. The quarter mesh material is then all reduced to pass a twenty-mesh screen, again halved, the balance reduced to pass a forty-mesh screen, and the final sample for assay passed through a hundred-mesh screen.

These numerous operations consume time and increase the cost of sampling work, but they are well worth while, because of the increased security felt in the correctness of the result.

The Methods of Computation Employed.

The computation of assay values proceeds in the following order: (i.) To obtain the average assay values on an average sampled width for certain defined lengths of level or winze; (ii.) from the results obtained under (i.), to calculate the tonnages and values of the developed blocks of ore.

The invariable method of computation of average assay values employed on the Rand is what may be termed the "geometrical mean" formula, in which the total inch-dwts. obtained by involving widths into assay values are divided by the sum of the widths. In general, this method gives results which are as correct as such figures can be, because the errors compensate one another, but there are certain conditions in which it gives very erroneous results, and only the prismoidal formula result is satisfactory. If space permitted, I would show a calculation of the four sides of an ore block by the two methods respectively, but the prismoidal involves such a lot of figuring, and consequently of space, that I must content myself with a list of assays, which we may suppose to represent a winze, sampled at ten-foot intervals. The calculations, as they would

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RAND MINING IN PICTURE



Circular Shaft, New Modderfontein Gold Mining Company, at commencement of sinking

Rand Mining in Picture

THE EAST RAND PROPRIETARY MINES



Cason Section, E.R.P. Mines



The Cason Shaft, E.R P. Mines

appear by the usual Rand method and the prismoidal method, are subjoined:—

Rand Method.

Width.	Assay.	Width x Assay.
3	10	30
6	8	48
4	15	60
7	9	63
30	50	1,500
10	10	100
40	35	1,400
35	60	2,100
60	45	2,700
195	...	8,001

$\frac{195}{9} = 21.66''$ $\frac{8001}{195} = 41$ dwt.

Assay value 41 dwt. on a width of 21.66 inches.

Prismoidal Method.

Width.		Assay.	Width x Assay.
Ends.	Centres.		
3	...	10	30
...	9	18	162
6	...	8	48
6	...	8	48
...	10	23	230
4	...	15	60
4	...	15	60
...	11	24	264
7	...	9	63
7	...	9	63
...	37	59	2,183
30	...	50	1,500
30	...	50	1,500
....	40	60	2'400
10	...	10	100
10	..	10	100
...	50	45	2,250
40	...	35	1,400
40	...	35	1,400
...	75	95	7,125
35	...	60	2,100
35	...	60	2,100
...	95	105	9,975
60	...	45	2,700

$\frac{327}{16} = 20.44''$ $\frac{37,861}{20.44}$ $\frac{1,852}{6}$ $\frac{308{\cdot}66}{8} = 38.57$ dwt.

Assay value 38 57 dwts on a width of 20.44 inches.

It will be seen in the comparison made above that the usual Rand method gives both the width and value too high. If we imagine the figures to apply to a block of ore 400 feet long and 200 feet deep, the comparative results are more impressive, as under:—

Rand Method.—12,066 tons, assay 41 dwts. Total ounces in block, 24,375.

Prismoidal Method.—11,333 tons, assay 35·57 dwts. Total ounces in block, 21,855.

Figures in excess using Rand Methods.—750 tons of ore and 2,880 ounces of gold, having a gross value £12,700.

The prismoidal formula should therefore be used when, as in the instance above taken, the highest widths and greatest values are in conjunction; or conversely, when the lowest values and greatest widths conjoin in the majority of the samples, as it sometimes happens, the prismoidal formula should be used, because, in such a case, the Rand method will give a result lower than the actual.

For calculating the tonnage and average value of developed blocks of ore, the method used on the Rand is, first to sample the block at regular intervals on four sides, and, after getting the average width and value of each side by the geometrical mean formula, to involve the whole in one calculation, as illustrated hereunder. The block used for illustration is assumed to be 400 feet long and 200 feet deep, sampled at ten-foot intervals, and its tonnage and value have been computed firstly by the Rand method and secondly by the method which I suggest, which I will call the "tons-value" method.

Usual Rand Method of Calculation. (Geometrical Mean).

UPPER LEVEL.		
Width.	Value.	Width x Value.
60	16	960
50	17	850
60	12	720
65	9	585
70	10	700
60	4	240
70	5	350
65	7	455
60	6	360
40	8	320
45	5	225
50	7	350
55	6	330
60	4	240
45	7	315
40	8	320
50	5	250
60	6	360
65	4	260
40	7	280
55	5	275
70	4	280
40	8	320
60	5	300
55	4	220
80	3	240
45	6	270
50	7	350
45	8	360
60	2	120
55	4	220
70	5	350
65	6	390
60	7	420
55	5	275
60	11	660
55	14	770
50	15	750
45	16	720
50	18	900
50	17	850
2,275	...	17,430
41	...	2,275

$\frac{2,275}{41} = 55.5$ In. $\frac{17,430}{2,275} = 7.67$ Dwts.

LOWER LEVEL.		
Width.	Value.	Width x Value.
70	5	350
65	5	325
60	4	240
50	6	300
55	7	385
60	6	360
60	14	840
55	16	880
60	12	720
65	10	650
45	18	810
50	15	750
60	14	840
70	12	840
65	11	715
60	9	720
55	10	550
60	7	420
65	6	390
70	5	350
45	4	180
50	3	150
55	6	330
60	5	300
65	4	260
70	5	350
65	6	390
60	7	420
55	5	275
60	6	360
70	4	280
65	2	130
50	6	300
55	5	275
45	7	315
60	3	180
55	5	275
50	6	300
55	10	550
60	14	840
70	15	1,050
2,420	...	18,942
41	...	2,420

$\frac{2,420}{41} = 60\ 05$ In $\frac{18,942}{2,420} = 7.83$ Dwts.

LEFT WINZE.		
Width.	Value.	Width x Value.
60	16	960
55	15	825
65	15	975
50	13	650
60	12	720
70	8	560
60	7	420
80	6	480
75	6	450
55	7	385
60	5	300
70	6	420
75	4	300
80	5	400
55	6	330
70	7	490
65	5	325
80	4	320
55	7	385
60	6	360
70	5	350
1,370	...	10,405
21	...	1,370

$\frac{1,370}{21} = 65.2''$ $\frac{10,405}{1,370} = 7.6$ Dwts.

RIGHT WINZE.		
Width.	Value.	Width x Value.
50	17	850
55	16	880
60	14	840
40	18	720
45	17	765
60	12	720
70	10	700
75	15	1,125
60	14	840
50	15	750
65	10	650
70	15	1,050
60	14	840
50	18	900
45	16	720
55	12	660
60	14	840
65	15	975
70	12	840
65	11	715
70	15	1,050
1,240	...	17,430
21	...	1,240

$\frac{1,240}{21} = 59''$ $\frac{17,430}{1,240} = 14.05$ Dwts.

VALUE OF THE BLOCK.				
Distance Sampled.	Mean Width.	Distance x Mean Width	Assay Value.	Distance x Width x Assay Value.
400	55·5	22,200	7·67	170,274
400	60·05	24 020	7·83	208,076
200	65·2	13,040	7 60	99,104
200	59 0	11,800	14·05	165,790
...	...	71,060	...	643,244
...	...	1,200	...	71,060

$\frac{71,060}{1,200} = 59.22''$ $\frac{643,244}{71,060} = 9{\cdot}05$ Dwts.

Rand Mining in Picture

THE GENERAL MINING AND FINANCE GROUP



Roodepoort U.M.R., Transformer House



Roodepoort U.M.R., The Kimberley Shaft



West Rand Consolidated Mines— General View

Result by usual Rand Method.

Value of the Block 9.05 Dwts on 59.22″ wide.

Tonnage in Block 32,866. Total Ounces 14,871.

Tons Value. Method of Valuation.

TONNAGE AND VALUE OF EACH SECTION.

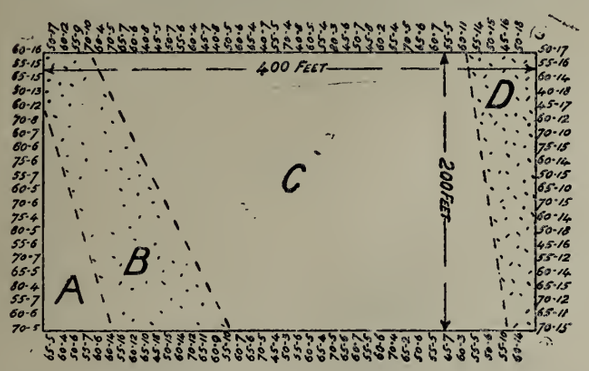
Section.	Area sq. ft.	Mean Vein Width ft.	C. ft.	Tons at 12 ft.	Assay Value.
A	4,800	5·21	25,008	2,084	5·89
B	15,200	4·9	74,480	6,207	13·41
C	53,000	4·75	251,750	20,980	5·66
D	7,000	4·8	33,600	2,800	14·13

Mean Width 57.72″

TOTAL TONNAGE x VALUE OF WHOLE BLOCK.

Section.	Tons.	Assay.	Tons and Assay.
A	2,084	5·89	12,272
B	6,207	13 41	83,235
C	20,980	5·66	118,746
D	2,800	14·13	39,564
...	32,071	...	253,817
...	...	....	32,071

32,071 tons. Average 7.9 dwts. Total ounces 12,668.



N.B.—In any column the widths (inches) are to the left and the values (dwts.) to the right.

The summarised results as arrived at by the two methods are as under :—

	(1)	(2)	(3)	(4)
Tons-value method ...	32,071	57.72	7.9	12,668
Rand method ...	32,866	59.22	9.05	14,871

(1) Total tons in block; (2) average width; (3) average value; (4) total ounces in block.

The Rand method, therefore gives the following excesses :—

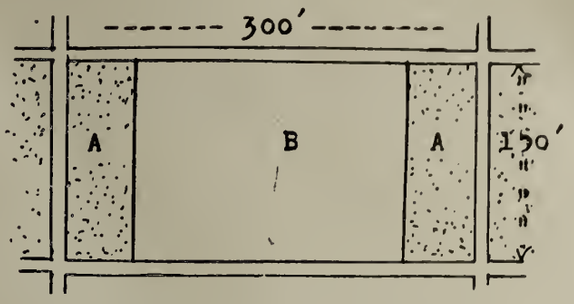
Excess in tonnage	795
,, average width (inches) ...	1.5
,, ,, value (dwts.) ...	1.15
,, ounces of gold	2,203
,, money value	£9,362

In the diagram used for illustration it will be seen that both in the tons-value method, which I propose, and in the Rand method the assays on all four sides of the block have been taken into the calculations. It is important to note that when using the tons-value method it is always correct to use the results from the four sides of the block for tonnage and value estimation, but when the Rand method is used, only in some instances should the four sides be involved in the calculations.

I am aware that the immediately preceding statement will cause some surprise, especially as in all text books, and in almost all practice, the assays on all four sides of the block, and the Rand method of calculation, are employed. But that it is very erroneous in many cases can readily be shown.

It is an universal principle in mine development to commence the winzes connecting levels in ore of good grade, not so much, perhaps, because of any technical advantage thereby secured, but because of the human tendency to make the best possible "showing" the mine is capable of.

As a consequence of the universal tendency just alluded to, the winze connections in a mine are very frequently in the heart of the best ore shoots. A very usual condition is that shown in the subjoined diagram :



A—High grade ore. B—Low grade ore.

The block of ore above illustrated is supposed to be 300 feet long by 150 feet deep. The winzes are sunk in rich ore, which occurs in vertical shoots and extends along the level for 50 feet from the winzes. The average sampled widths and values are :—

In the rich ore shoots, 3 feet wide, assaying 30 dwts. per ton.

In the poor ore shoots, 3 feet wide, assaying 6 dwts. per ton.

Computing the width and value of the ore in the block by the Rand method, the following result is obtained :—

500 feet of ore in rich shoots at 3 feet wide and at 30 dwts. value.

400 feet of ore in poor shoot at 3 feet wide and at 6 dwts. value.

Then :—

500 @ 3ft.	1,500 @ 30dwts.	45,000
400 @ 3ft.	1,200 @ 6dwts.	7,200
900	2,700	52,200
	900 = 3ft.	2,700 = 19·33dwts.

Result by Rand method :—

Assay value on a width of 3 feet (dwts.) ...	19.33
Tons in the block	11,250
Ounces of gold in the block	10,873
Money value in the block (gross)	£46,210

Computing the figures for the block by the tons-value method, we get the following :—

Area of high grade ore (square feet)	15,000
Width of high grade ore (feet)...	3
Total cubic feet	45,000
Tons, at 12 cubic feet per ton	3,750
Area of low grade ore (square feet)	30,000
Width of low grade ore (feet)	3
Total cubic feet	90,000
Tons, at 12 cubic feet per ton	7,500

Then :—

3,750 tons of high grade ore @ 30dwts.	112,500	
7,500 ,, low ,, ,, @ 6dwts.	45,000	
	157,500	
11,250	11,250	= 14dwts.

Result by tons-value method :—

Assay value on a width of 3 feet (dwts.) ...	14
Tons in the block	11,250
Ounces of gold in the block	7,875
Money value in the block (gross)	£33,468

The summarised results as arrived at by the two methods respectively are as under :—

	(1)	(2)	(3)	(4)	(5)
Rand method ...	11,250	3 ft.	19.33	10,873	46,210
Tons-value method ...	11,250	3 ft.	14.00	7,875	33,468

Rand Mining in Picture

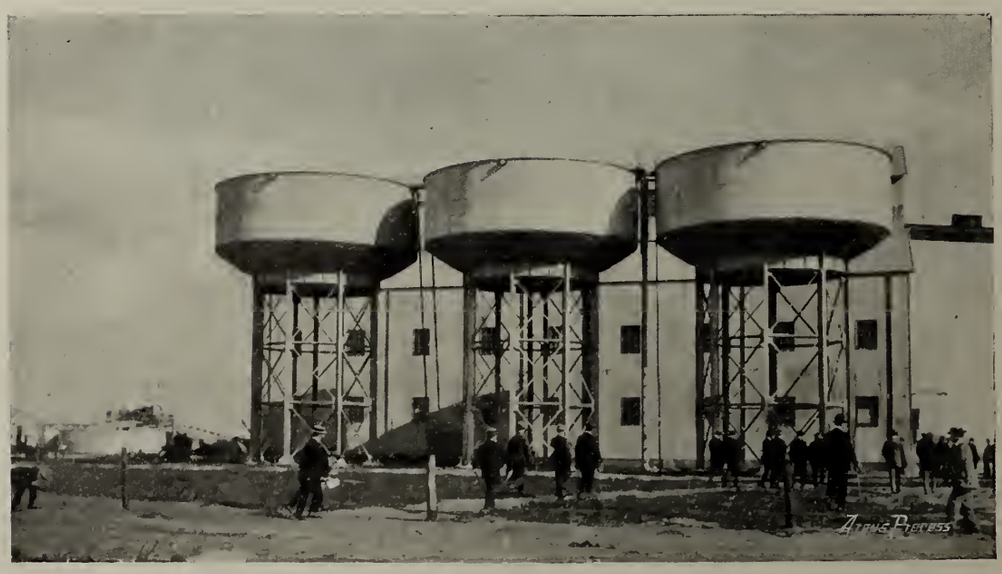
THE GENERAL MINING AND FINANCE GROUP *(Continued)*



West Rand Consolidated Mines West Shaft and Crusher Station



Slime Plant, Meyer and Charlton



Roodepoort U.M.R. Mill and Mill Supply Tanks

(1) Total tons in block; (2) average width; (3) average value; (4) total ounces of gold in block; (5) gross money value in block.

The Rand method, therefore, gives the following excesses:—

Excess in valuation, in dwts.	5·33
,, ounces of gold in the block ...	2,998
,, gross money value in the block ...	£12,740

The excesses in the gold content disclosed by the Rand method is so serious and striking that some explanation is demanded as to why it gives such an erroneous result.

The reason is clearly that within the high grade ore there is a greater length exposed for assay per ton of ore than in the lower grade; in other words, the Rand method introduces the higher grade assays into the final calculation a disproportionate number of times as compared with the lower grade assays.

The foregoing illustration shows that when the Rand method of calculation is employed, great judgment must be used in deciding how the assay values should be handled.

We have demonstrated that if four sides of the block of ore be taken and involved in the Rand way, great errors result. We can, in fact, draw the remarkable generalisation that in cases in which the ore occurs in vertical shoots, with the winzes in those shoots, as is shown in the diagram, the application of the Rand method will give erroneous results unless only two sides of the block are calculated, namely, those along the levels, using, of course, for the winze section, both on the upper and lower levels, a figure representing the computed average derived from the winzes, and the distance taken into calculation with them on the two levels.

Ore, to be correctly valued by the Rand method, must have an exposure proportionate to the tonnage of high and low grade ore in the blocks, as we have seen.

On the other hand, for the purposes of valuation by the tons-value method, every available figure must be used, and the more numerous the assay points, the nearer will be the result to the true one.

In the case shown in the diagram, the valuation as made by the tons-value method is much more accurate for the high grade area than for the low grade, assuming the ordinary fluctuating values within the bodies of ore, for the reason that one assay result only applies to thirty-five tons in the high grade areas, but, owing to the lesser exposure, it has to cover ninety tons in the low grade areas.

The multiplication of assay results, however, beyond a certain point is valueless unless the assays refer to fresh exposures in the block of ore. For this reason, ore valuation, by whatever method appraised, is only accurate in proportion to the actual exposure made, and the relative accuracy of any final valuation can only be gauged when it is known what exposure there is on a given block or blocks of ore, proportionate to the tonnage contained.

In the block we have been considering, for instance, there is an exposure of one foot of ore face in the high grade ore for every 7.5 tons in the areas, whilst in the low grade area the exposure is only one foot of ore face for every 18.75 tons.

It should be established as a criteria for careful ore valuation, therefore, that the exposure should not be less than one foot for every twenty-five tons of ore in the low grade areas, and that the nearer it approached one foot for every ton of ore in the high grade areas the more accurate the final estimate of the value.

Naturally, the economic aspect must receive its due consideration, and in very low grade ores the limit might be much higher than I have suggested, for the very simple reason that there are no possibilities for very wide variation in the ultimate results, because there are no violent differences in ore of the class indicated. But in high grade ores the possibilities for wide variation and eventual error on sparse data are infinite, and therefore the proportionate exposure to tonnage should be high, especially as ores of this class can presumably bear heavier charges.

On the Rand, the operations are now conducted on such a large scale that variations in value from the actual, even though apparently trifling for the unit, are of the greatest importance in the aggregate. It is, therefore, of material interest to the Rand that ore valuation should be conducted upon the soundest possible lines, and therefore I offer the suggestions in this paper to my professional colleagues in the hope that they will prove to be of some practical value.

RAND SCIENTIFIC SOCIETIES



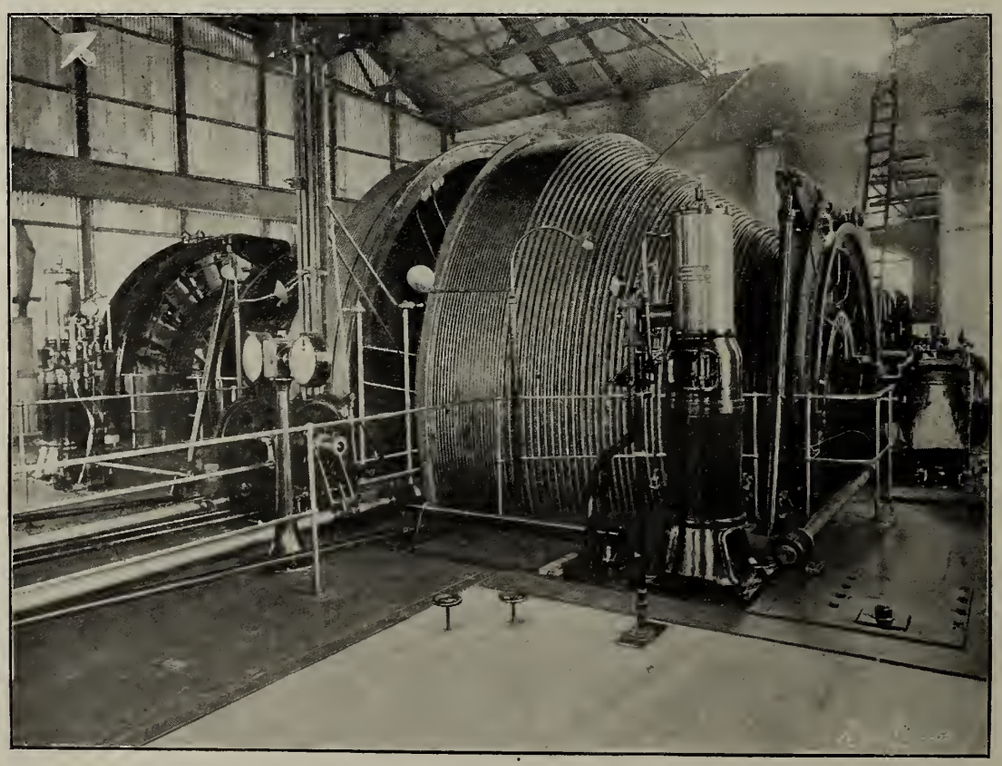
South African Institution of Engineers at Randfontein

Rand Mining in Picture

THE GENERAL MINING AND FINANCE GROUP *(Continued)*



New Steel Headgear, Meyer and Charlton



Electric Hoisting Plant, Cinderella Consolidated

The Origin of Alluvial Diamonds

By DAVID DRAPER
(Honorary Member, Geological Society of South Africa)

THE first discovery of diamonds in South Africa took place in 1868 on the banks of the Vaal River, though a few were found near the Orange River, in the vicinity of Hopetown. Since then alluvial digging has been constantly going on, especially near the original spot, but also in many other parts of the country. In fact, so widespread are the areas in which diamonds are found in gravel and river washes, that they may be said to occupy a belt of territory stretching from German West Africa to Somabula, in Rhodesia, and southward to the upper valleys of the Vet River in the Orange Free State.

The most productive area so far discovered lies between the village of Bloemhof and the junction of the Vaal and Orange Rivers, and in this locality thousands of diggers have been engaged in washing operations for the last forty-four years. Many have made fortunes, but it is doubtful whether, upon the whole, the average earnings of these men have proved to be remunerative.

Still the fascination of diamond digging is so great that it is very difficult to get away from a business where any turn of a sieve or clean up of a run may mean a small fortune. "The next sieve," as one old digger put it, "may contain a diamond that will pay my way for a month," and it is always "the next sieve" that keeps them hopeful.

But since the first discovery men's minds have been occupied in endeavouring to trace the spot from which the enormous number of diamonds that have been found up to date were derived. No correct figures of the gross value of the alluvial diamonds found in this country are obtainable, but the total must amount to several millions, and the good quality of the alluvial diamonds is so well recognised that the diamond buyer is always prepared to pay a high price for a river stone.

When diamonds were found on the banks of the Vaal, at what is now known as Barkley West, several expeditions were fitted out for the purpose of exploring the tributaries of the main watercourse, as the promoters were of opinion that the origin of the glittering gems which they were seeking must be in the high land where the river originated. But no discovery of any note has been made up to the present in the course of any of the rivers emptying their waters into the Vaal, and even those mines which lie in the valleys, such as the Lace, the Monastery, Voorspoed, and others, are too poor to have produced the large number of stones of great size that have been found in the gravels of the Vaal River.

Naturally, several theories have been advanced to account for the alluvial diamonds of the Vaal River Valley, and one of the oldest, though recently revived, is

Their Derivation from the Amygdaloidal Diabases.

Notwithstanding the fact that no diamond has yet been found actually in the diabase—though Mr. H. S. Harger has a specimen in a rock of doubtful structure, but somewhat resembling diabase—the originators of this theory have written many pages in order to convince their readers that their deductions are correct.

They completely overlook the fact, however, that many millions of diamonds have been taken out of the various mines containing "kimberlite," that this rock exists in every country where diamonds have been found, and it is now considered to be the true matrix of the diamond. They also neglect to explain how a large crystal of carbon could survive the intense heat, under exposure to the oxygen of the atmosphere, which had access to the scariaceous lavas we now term amygdaloidal diabase.

So soon as any mass of molten mineral is released from pressure by reaching the surface of the earth's crust, it will naturally come into contact with the oxygen contained in the atmosphere, and this, combined with its own high temperature, would consume the carbon crystals.

Then, how do they account for large crystals in an exceedingly fine-grained base? Unless the crystals of carbon are porphyritic, and have crystallised out of the carbon contained in the diabase, which is highly improbable, the theory falls to the ground.

Kimberlite is a coarsely crystalline rock containing many varieties of minerals, and the majority of these are comparatively of large size. In such a rock, especially as it is known to be of deep-seated origin, diamonds would have a chance of surviving, when once the crystals were formed.

The fact that the country rock in evidence in the alluvial diamond deposits of the Vaal River Valley is amygdaloidal diabase, belonging to what is now known as the Ventersdorp system, is brought forward as substantiating the diabasic origin of the diamonds, but, from the point where the Vet River joins the Vaal, the diamond deposits on the southern side of the river are not in any manner associated with diabase. On the contrary, the underlying rock is Karoo shale, the alluvial deposit consists very largely of fossil wood, and it would be equally reasonable to assume that the vegetable matter, now petrified, was the original parent of the diamond because it is found associated therewith, as to state that because amygdaloidal diabase accompanies the diamond in the lower reaches of the Vaal River, therefore they have weathered out of its mass. In different parts of the country alluvial diamonds are found associated with deposits of a totally different character. At the Seta mine, on the Limpopo, corundum and almandine garnets, cemented together in a calcareous matrix, make up the principal elements of the alluvium. At Somabula, in Rhodesia, various gem minerals, such as alexandrite and chrysoberyl, as well

Rand Mining in Picture

THE GENERAL MINING AND FINANCE GROUP *(Continued)*



Control Switch Gear, Rand Collieries



West Rand Consolidated West Shaft

as topaz, blue in colour, was found in the diamond-bearing deposits. On the Vaal River, ordinary pyrope garnets and some ilmenite (carbon) are found in the gravel, but the chief guide to the diamond digger, pointing to the richer spots, is what is known as the "bantam," a corruption of the Dutch word "bandom," or banded; but, unfortunately, every digger prefers his own variety of bantam, and each new field appears to have a new kind. This variety of pebble is really only the mineral of higher specific gravity contained in the deposit, and on this account its association with the diamond is merely a case of selection by gravitation. In an ordinary gravitating machine all the heavier minerals collect together, and in nature's great gravitating operations the same law is in force. So there is some reason in the diggers' assumption that where bantams are plentiful there will be diamonds.

In German West Africa feldspar and quartz appear to be the only minerals accompanying the diamonds, and this is the natural result of concentration in a country where granitic and gneissic rocks play such an important part.

The Vryburg diamonds are found in a hard white limestone, and the gravel is largely composed of amygdales weathered out of rocks similar to those composing the highest peaks of the Drakensberg, and known as pipe amygdaloids, a variety of pebble also found in the Vaal River fields.

At Mooifontein and the diamond-bearing farms in its vicinity, the rocks associated with the diamond are generally angular and show very slight evidence of having been submited to the abrading influence of running water; though there are numbers of rounded amygdales in the gravel, they are generally pitted, and appear to have dropped out of the Ventersdorp amygdaloidal diabase which is the country rock in this neighbourhood.

It will thus be seen that each alluvial field differs from any other, and consequently any theory built up on the examination of an isolated area is bound to be out of concord with the evidence in any other district.

There is another point which most investigators have overlooked when investigating and describing the alluvial diamond fields of South Africa, and that is that no diamonds (or at any rate very few) have been found in the river valleys of the Orange and Caledon Rivers, yet there are magnificent river terraces flanking both these streams, and made up of minerals identical with those of the Vaal and the Vet, minus the principal factor—the diamond.

Finally, the diamond-bearing gravels on the river terraces flanking the stream which drains the Premier (Transvaal) diamond mine must be mentioned, but as the gems in this deposit can apparently only have been derived from that enormous diamond-bearing pipe, their origin is beyond a question of doubt, and in dealing with the source of alluvial diamonds this field may be omitted for that reason.

From Where do the Alluvial Diamonds Originate?

That portion of South Africa known as the Karoo has for many years been the seat of the greatest diamond mining industry in the world, and until the Schuller mine, on the farm Rietfontein, near Pretoria, was discovered, diamonds were not supposed to exist away from the Karoo beds. But this discovery proved the contrary, for this pipe, as well as the Premier and several other pipes in the vicinity, lies either in the Magaliesberg quartzites or in the felsites generally associated with them. Still, as it must be admitted that the beds on which these pipes are now situated have only been laid bare by the forces of erosion, causing the removal of perhaps thousands of feet of Karoo beds, remnants of which can still be found in their immediate vicinity, it is highly probable that these pipes intersected the Karoo beds as well.

It is generally admitted that the period during which the diamond-bearing pipes perforated the earth's crust was what is known as the "upper Karoo," and the Monastery mine, situated in the "cave sandstone," is accepted as evidence of this. This being the case, the diamond mines of other parts of the country, such as Kimberley and De Beers, represent merely the stump of the old volcanic necks, the remnants left after thousands of feet of Karoo beds were carried away by the summer storms and winter winds, disintegrated by the frosts of the cold months and the penetrating waters of the wet seasons. By these influences the surface enrichment of these mines can also be accounted for. The diamond being the hardest and most durable mineral in a pipe, would remain "in situ" when all its accompanying minerals had succumbed to the all-powerful influences of the atmosphere.

During this long-continued period no doubt many changes in the flow of the surface waters took place. Streams eroded their channels in strata now covered by hundreds of feet of more recent deposits; a gradual lowering of the whole surface took place, and probably hundreds of pipes and fissures were planed away, each one adding its quota of diamonds to the general deposits of the country, patches accumulating in places where amygdaloidal diabases formed the country rock, others where Karoo beds underlay, mixed with the debris of the harder formations or minerals contained in the strata undergoing disintegration, so the gems would be found in one part of the country associated with minerals differing entirely from those which accompanied them elsewhere.

That the diamonds were not brought from their original position by the present rivers is proved by the fact that diamond-bearing areas are found where there is absolutely no evidence in favour of fluviatile action, such as on the farms Mooifontein, London, and other properties in their vicinity. Even the diamond gravels of the Vaal River are the remnants of greater areas which extended far from the river banks, and through which the present stream has cut its course. All the known diamond productive mines, with the exception of



Opening a Diamond Prospect
Incline Way to Diamond Paddock, Pniel Estate

Rand Mining in Picture

THE GENERAL MINING AND FINANCE GROUP *(Continued)*



Rand Collieries



Electric Winders, Rand Collieries

the Premier, are situated within the drainage area of the Vaal River and its tributaries, hence it follows that the alluvial diamond-bearing gravels will be found in the same part of the country. That there are no diamond-bearing gravels in the valleys of the Orange and the Caledon Rivers is substantial evidence that there are no diamond-bearing mines in the area drained by these rivers.

It is not the writer's intention to prove that the alluvial diamonds have been carried from the present productive mines by the streams visible to-day; on the contrary, the present streams have been a very insignificant factor in the production of these important beds, which are the result of the destruction of many rich pipes, and the subsequent gradual lowering of the heavier minerals by ordinary weathering influences until they found a resting-place in the areas where they are now being found. Such lowering influences are still in operation, and in course of time the diamonds now being found would have sunk to still lower levels had they not been removed by the hand of man.

That fluiatile action assisted in collecting the heavier constituents of the whole mass which was being operated on is beyond a doubt, but it was by no means the principal factor in the operation. If the diamonds had been transported from higher ground by the present streams, the richness of the deposit, as well as the large sized stones, would be found in those parts of the valley which lie nearest the source from whence the diamonds came; but this is not by any means the case. The gravels appear to become poorer in the upper parts of the Vaal River Valley, and, in fact, though similar gravels are found as far up the river as the village of Parys, they contain very few, if any, diamonds, and though the Vet River Valley contains similar gravel, in no place has it yielded a remunerative return.

An Ancient Alluvial Deposit.

There are indications known to a few geologists who have not, for want of more detailed evidence, seen fit to publish their discovery, of the existence of an ancient alluvium which contains many of the minerals associated with the diamonds in their original matrix—the kimberlite pipes.

The bed containing these accessory minerals is made up largely of felspar, often pink in colour, mixed with quartz, jasper, both yellow and red, and in places pyrope garnets, identical with those found in diamond pipes, are very abundant, as well as ilmenite and occasionally worn crystals of olivine or green-coloured minerals of the same family are found therein. Wherever this bed is found, the "indications" of a diamond mine are so pronounced that many syndicates, and even companies, have been floated on the debris of the "felspar bed," the name given to it by its discoverers. In the debris from this bed, wherever it has collected in the valleys, diamond deposits occur, the most notable of which is that on the farm Blydschap, where a fairly rich patch of alluvium was worked some years ago.

The felspar bed is interstratified between the coal-bearing standstones, also very felspathic, and the red beds, and it is very well developed in the district of Winburg and Ventersburg, while traces of it have been discovered in both the Standerton and Middelburg districts, also in Boshof and Jacobsdal, and a specimen of an identical rock was brought from German South-West Africa by Mr. H. S. Harger. The destruction of this rock by ordinary atmospheric influences would release the harder and more durable minerals contained in its mass, and these, becoming disseminated in the surface soil, would produce the "indications" so eagerly sought for by diamond prospectors, and mislead them in their endeavours to trace a diamond mine.

That this now interstratified bed was derived from the destruction of a land surface in which diamond pipes were in existence is highly probable, and consequently its disintegration would account for the existence of diamonds in parts of the country where pipes have not yet been discovered. Where the "felspar bed" happened to be rich in diamonds, its debris would produce a field containing perhaps a payable quantity of gems, and as there is no doubt that the diamonds would not be evenly distributed throughout its area, and, in fact, in many parts it might be quite barren, the diamonds would be very unevenly distributed and absent over large areas.

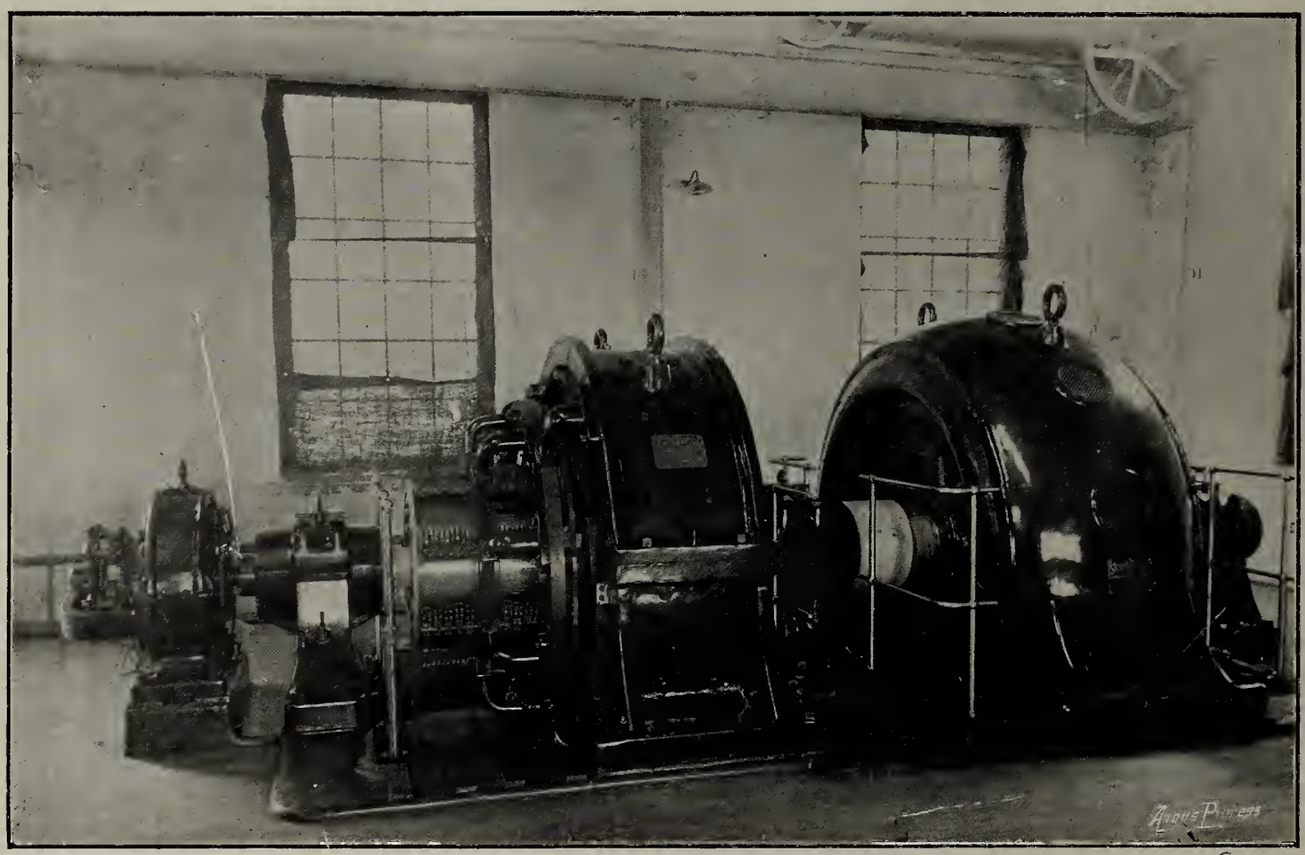
Accepting this bed as the source, at any rate of some, of the alluvial diamond-bearing gravels, the wide-spread areas in which they are found, as well as the diversity of their character, can be accounted for without the necessity of theorising on the probability of the amygdaloidal diabase being the original matrix of the alluvial diamonds of the Vaal River Valley.



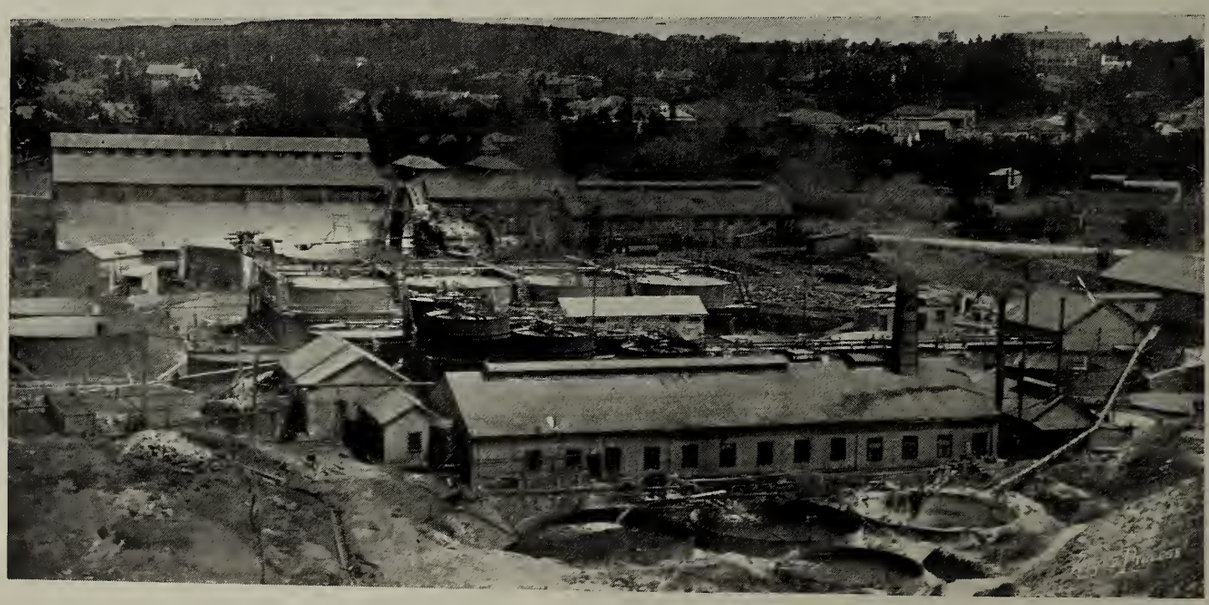
A Diamond Prospect, Griqualand East

Rand Mining in Picture

THE GENERAL MINING AND FINANCE GROUP *(Continued)*



Rand Collieries 6 Ton Converter



New Goch Recovery Works

Evolution in Metallurgy

Progress of Metallurgy of Gold on the Rand Reviewed and Discussed

By H. A. WHITE, M.I.M.M.
(Consulting Metallurgist, Messrs. Goerz & Co., Ltd.)

IN the field of biology one of the most interesting of its unsolved problems relates to the method of evolution. Three views still struggle for supremacy. The older Darwinian idea of a fortuitous progression, out of which the future is cut by the knife of natural selection, is perhaps losing ground. The more modern idea is that a natural trend in definite directions is one of the properties of the succession of living protoplasm. Recent experiments with certain flowering plants have suggested the notion that this progress may be one of jumps rather than by imperceptible changes in the succeeding generations.

In the more artificial struggle of mankind to obtain control over natural conditions, on the whole the progress has been of the more gradual kind, but there can be no doubt that many important steps are discernable, which have greatly accelerated the rate of advance. The invention of the steam engine and the manifold uses of electricity have changed the face of the world with extraordinary rapidity, but all such examples, upon examination, reveal as their base the application of some new principle, and only very slow progress is ever based upon the manipulation of known ideas after the manner of the mediæval scholiast. Some advance can always be made by the refinements suggested by experience of the new devices, but in general this is of quite secondary importance.

These general statements are usually accepted to be true in theory, but in practice they are frequently ignored, and very great advances are claimed by the advocates of newly patented processes where no new principle whatever is involved and where a rechauffe of well-worn ideas is relied upon for the novelty specified.

Consider, for example, the progress of metallurgy upon the Witwatersrand. At first the only method of extraction of the gold was by means of the prehistoric method of amalgamation, and the advances shown on the methods of fifty centuries ago were small and almost entirely mechanical. Small improvements, such as the use of finer screens and more careful separation of the richest portions of the tailing alone took place until the advent of the new idea—the chemical solution and precipitation of the gold. Of the chemicals proposed chlorine and its congeners proved but a side track to the path of progress, but the use of cyanide of potassium speedily led to very great advances in the metallurgy of gold. It is well to remember that even in the earliest stages of the application of this new idea many methods were tried and abandoned which form the basis of what are to-day sometimes called "new" processes.

The next great step, also of very great practical importance, was the adaptation to the treatment of slime of the process which MacArthur Forrest had so successfully applied to the sand only. This new principle, due chiefly to Williams and Butters, was the idea of decantation after settlement of the solid from which the gold had been dissolved. In this instance, also, several unsuccessful methods were tried and found wanting, but new revivifying ideas have been applied to some of these failures, as, for instance, the introduction of filtration under atmospheric pressure through vertical membranes. Once again progress became slow, but some little advances were made in the application of these new ideas, resulting in the increased extraction of gold through more scientific application of solutions, and decrease in working cost chiefly due to improved mechanical devices for handling the materials.

It had long been known and regretted that a considerable amount of the precious metals remained locked up in the residue because of its mechanical inaccessibility, and various unprofitable attempts had been made to solve this difficulty—mainly one of finer crushing. This difficulty was largely overcome by Denny's introduction of a new idea due to Dr. Diehl. This was the use of the tube mill for crushing gold ore with water by means of lumps of silicious material. With the advent of the tube mill it has been remarked that the field left for future advance had become seriously narrowed. For instance, the extraction of gold was now economically possible up to 95 per cent., as compared with 60 per cent. by amalgamation only, increased by the cyaniding of sand up to 85 per cent., and by the inclusion of the decantation process for slime pushed on to 90 per cent. It was evident, therefore, that the line of decreased cost was becoming of more importance than increased extraction.

It happened, however, that the next important step, while aimed in the more profitable direction, effected a certain, though not large, increase in extraction. Illustrating the greater difficulty of progress, two distinctly new ideas were requisite, and both were due to Dr. Caldecott. The moving horizontal filter for sand involved the further new principle of separation of sand, with only a small quantity of water, by means of a diaphragm support in a cone classifier. An old difficulty in the way of successful treatment of crushed ore has always been known from the early days, and its evasion was well understood to lie in the direction of perfect separation of the two products—sand and slime. In other countries this difficulty has been avoided by new methods of treating both products together. This lies under the grave disadvantage that the gold in the slime is usually much more rapidly dissolved than that in the sand, owing to its finer state of division, and consequently time, space, and power must be wasted by such methods. By means of the diaphragm cones, the first really satisfactory solution of this problem was effected, and by means of double washing an extraordinarily

Rand Mining in Picture

THE GENERAL MINING AND FINANCE GROUP *(Continued)*



West Rand Consolidated Electric Winders at West Shaft

perfect separation is made automatically, so that this new principle is applied (for example at Brakpan) where the logical sequel, the Caldecott table, has not yet been installed. The last case, however, well illustrates the fertility of a new idea, for here, as in several other plants, the principle involved is applied to the regulation of the tube mill feed, an application due to the late G. O. Smart.

Two new principles are now struggling for recognition on the Witwatersrand—the vacuum filter idea and that of the use of zinc dust with a pressure filter. One of the earliest attempts to treat slime involved the application of a vacuum to a filtering surface—but this was horizontal and very limited in area. By the use of vertical filtering leaves a very great surface can be exposed in a relatively small space, and it was this new idea which led to the success which has been achieved. Now there is nothing very novel in this, and, in accordance with the principles laid down, it is probable that the advance made is not of first-rate importance. The scale of operation here is so vast, however, that any real advance, if certain, however small, becomes worthy of consideration. This consideration has always been forthcoming, and wise conservatism, which is sometimes the occasion of reproach in the mouths of unwary outsiders, has never hindered the welcome to new ideas, though it has often blocked the path of meretricious proposals where the real object has been the separation of gold from the speculative investor.

It has been claimed that the average benefit to be derived from the replacement of the decantation process (time-honoured but not yet outworn) by vacuum filtration of slime is in the neighbourhood of 1s. 10d. per ton of slime for the mines of the Witwatersrand. As there are several large mines where the total cost of the process added to the whole of the residual gold is less than this amount, it may at once be said that such a statement reflects more enthusiasm than judgment; but it illustrates a remark in the preliminary paragraphs of this contribution.

It is natural that the first plants where a new process may hope to replace an old one are those where some peculiarity causes that old process to work at a relative disadvantage. For example, the slime at the Bantjes settles badly, and residues by decantation were naturally much above the average. Two cases might have arisen: (1) Efficient settlement if more time given; (2) the physical properties of the slime were such that in no reasonable time could a fair settlement be obtained. In case (2) it may be remarked that the properties upon which efficient filtration depend are similar to those involved in rapid sedimentation, so that a difficulty would remain for either process, more serious, however, in the case of the older method. If, however, it was a matter of more time only, it becomes a question if the extension of plant required is more profitably made by increasing the number of settlement vats or by putting in a vacuum filter plant.

The advantages obtained in the latter event can only with safety be compared with results to be obtained by the former method, for as far as capital cost is concerned it will usually be cheaper to extend the decantation plant—even by introduction of third wash vats also. Where then is the real advance? This, upon examination, will be found to depend upon the principle of replacement and its advantages over the method of washing by successive dilution. However many washes may be given, followed by settlement and decantation, a fraction of the original dissolved gold must remain; but by displacement washing on the filter it is theoretically possible, and in practice not too difficult, to entirely replace by barren solution that containing gold in contact with the slime.

Such dissolved gold in the best modern plants cannot economically be reduced below a value of threepence per ton of dry slime by means of the decantation process, and in practice is about one penny per ton with the vacuum filter. As the extra cost of filtration is not less than threepence per ton, it is, therefore, clear that the successful field with the latter will be where either the original value of the slime is high, settlement is not good, or the gold is dissolved with unusual slowness. This latter quality is circumvented in the filter process because of the introduction therein of the rapid and economical solution of gold by means of air agitation in tall and narrow vats. A further advance in this direction will be made by the adoption of the idea of continuous treatment in these "Brown" vats which at present are used intermittently, except on the East Rand mines.

The new idea rendering feasible the use of zinc dust is chiefly manifest in the peculiar construction of the Merrill filter press. The capital cost is larger than that involved in the more usual zinc-shavings process for the precipitation of gold from its solutions. This is only partly offset by the complete elimination of the "carry-over" of gold in the form of partly-coated zinc. As the value of gold locked up in this way is not an easily and definitely ascertainable quantity, it is obvious that there may be cases where this one advantage may be of paramount importance. It must be remembered that the gold left in the boxes may always be sold for full market value upon the death of the plant, whereas a filter press is sometimes unsaleable at even a fraction of the cost of putting it in its place. The plants using this zinc dust method, so far, find a greater expense for cyanide and zinc and a great difficulty in keeping the effluent below 0.03 dwt. in value, though 0.01 dwt. is easily obtained with regularity in the more common zinc-shaving plant. A reason for this may be seen when it is observed that the area of metal exposed, multiplied by the time of contact with the solution, is very much less than the like product—which rules such chemical actions—in the case of zinc shaving, especially where this is cut as thin as possible.

There are many other improvements in methods and application which might be mentioned, some now undergoing trial and some which have been already shown to be off the line of evolution of gold metallurgy, but the main advances of the future, if we rely upon the history of the past, will depend upon careful study of the facts and the adaptation of new ideas to solve the problems thereby disclosed.

RAND MINING IN PICTURE



Benoni Consolidated, No. 3 Shaft

Rand Mining in Picture

VIEWS ON JOHANNESBURG CONSOLIDATED INVESTMENT MINES





Views of Plate House and Cam Shaft Floor, Langlaagte Consolidated

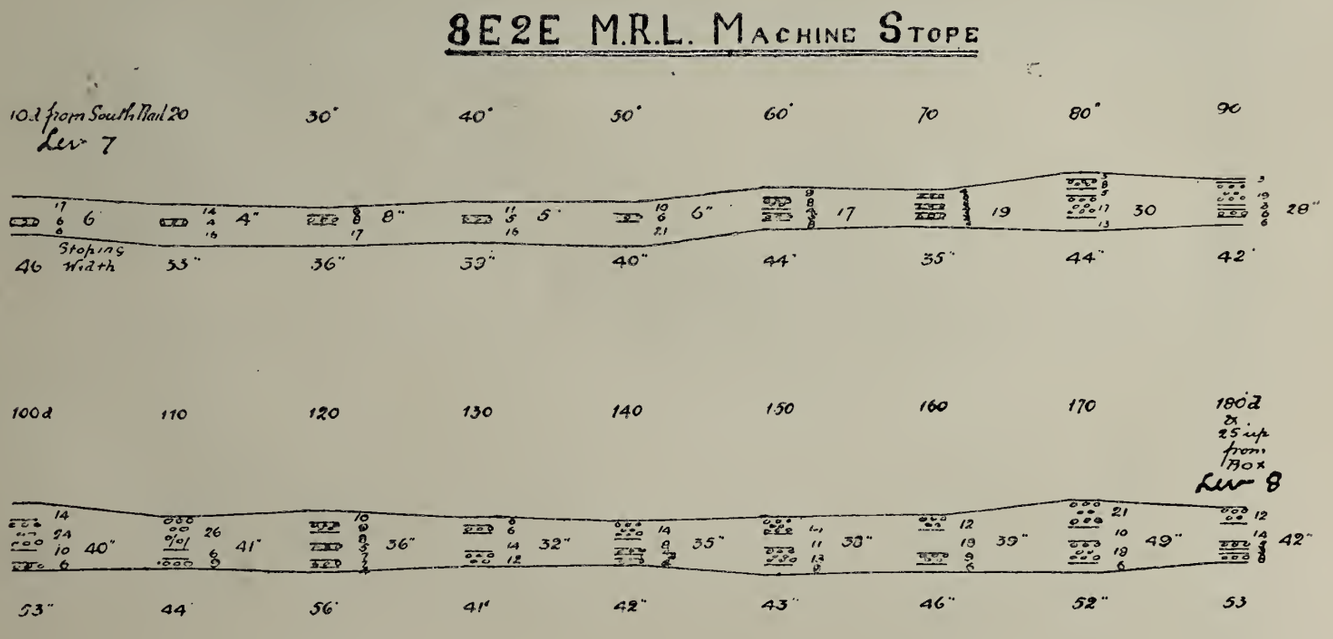
A Defence of Large Machines

How they are Favoured by Conditions and Nature of Ground in many cases

By J. P. WARD
(Manager, Aurora West Gold Mining Company, Limited)

IT is apparently very much out of fashion to say anything in favour of large machines on the Rand, but, personally, I must say that, for the conditions and nature of ground I am dealing with, I have found little inducement to adopt small machines, and that large machines, 3¼ inch, are very much alive and firmly established for stoping work.

I would describe the rock under consideration as rather harder to drill than the average, fairly free breaking, and having usually fairly well defined hanging and foot partings, the roof strong and good. The only risk we run is of false bedding in the hanging, that is, of a layer of six inches of hanging waste with a smooth upper hanging, which may, and frequently does, develop into a thickness of two to four feet if allowed to be broken, and once these wedge-shaped pieces are started, they may break away and give trouble. When experimenting with small machines, I found I could get the same lineal footage drilled per machine as with large machines, but that the breaking value of the hole, due to the smaller diameter, was less than 75 per cent. of the large hole, and that my stopes were of equal width. I have, further, not yet seen returns from any mine where total costs per fathom for small machine stoping were as low as the costs for large machines, and I can only make profits on large fathomage. I show a sketch of a current machine stope showing over all reef width, and alongside is given the stope width measured ten feet out from the face. This face is 220 feet long, and has been worked for twelve months with three machines, single shift. It reflects good work which small machines would have difficulty in beating, and which they could not approach for cost per fathom, when all charges for steel and air are fairly taken out.



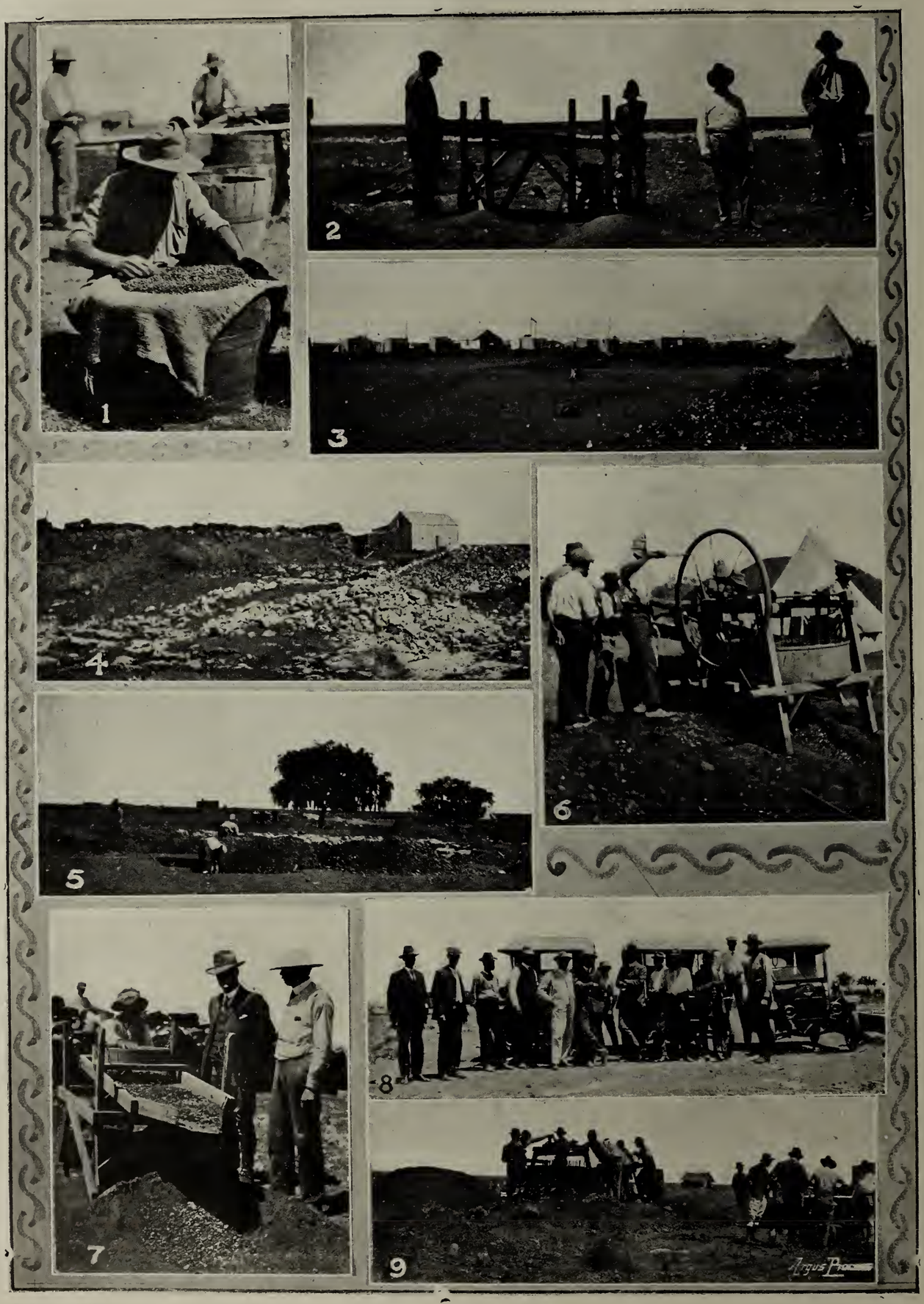
STOPE WIDTHS MEASURED 10 Feet FROM FACE

SCALE 10 Feet = 1 INCH

Generally ground which is badly faulted or likely to give trouble with 3¼ inch machines I reserve for hammer stoping. Machince as small as 3 inch are with us retiring from active business.

In our development I have always had difficulty in getting a "round" broken down in anything less than three machine shifts with air at 70 lbs. and 3¼ inch machines. Our development being well ahead, it is now

Views of the Mooifontein and London Diamond Diggings



1—Sorting on London 2—Prospecting and "Babying on London 3 A view of Mooifontein 4—Cattle Kraal on London where diamonds have been found 5—A view of a portion of London 6—Washing on Mooifontein 7—A "Baby" at work on London 8—A group on London; this includes Col. Bottomley and Mr. Morice, Mining Commissioners, and Messrs. Carlis, Oliver King, Roos (the vendor of London), Williams and Nuna Davis 9 A pan at work on London

all schemed for one machine per face ; after experiment on this basis first with 3¼ inch and then 3½ inch, I have finally arrived at a 3⅝ inch diameter machine, with which, except in occasionally very hard patches, we can now count on three "rounds" per week, single shift, with comparative certainty, two machine shifts with this 3⅝ inch machine being equal in efficiency to three with 3¼ inch machines.

I am aware that machines of this size have been used on the Rand before and allowed to go out, and I am further aware that our conditions may present difficulties to the 3¼ inch standard machine which it overcomes elsewhere. I am merely indicating that I had these difficulties, which were aggravated by the strict limitation of hours, and that by replacing the 3¼ inch large machine in development by a still larger machine I have met with success. The enormous weight of these machines, 390 lbs., is of no account in a drive where there is always room to get about it to lift it when necessary, while the machine drills with ease up to eight holes of six feet in a clear shift. I may add that for twelve months all "uppers" have been drilled wet under pressure water, under severe penalty to the miner found drilling dry.

In conclusion, for our conditions the large machine is anything but dead, and small machines will in future apparently be a healthy 3¼ inch, with the larger 3⅝ inch wherever there is sufficient duty in front of it and room to handle it. As regards drill steel, the same steels are used as for 3¼ inch machines. It shows signs of punishment, but I do not anticipate having to insert extra steels between the four bits now used, our standard new steels commencing with a 3 feet 6 inches long starter, finishing with an 8 feet chisel, which is withdrawn when it is worn short or approaches 6 feet 6 inches long.

RAND MINING IN PICTURE.—THE HEART OF THE RAND



Village Deep Gold Mining Company

Rand Mining in Picture



Electric Hoists as installed at the City Deep and Turf Mines

The Problem of Gold at Depth

AND ITS RELATION TO RAND BANKET

By HUGH F. MARRIOTT

MUCH has been said from time to time during the life of the Rand about the present and prospective decrease of value in depth, and it is now desirable that the line of argument as regards these fields should be put on a definite and rational basis.

The relations between the earlier mining records and those now being produced have been fully set forth in the contributions to discussion from Mr. H. S. Denny and myself on Mr. Schmitt's paper (Transactions I.M.M., London, Chemical, Metallurgical and Mining Society, South Africa), and need no further elaboration here. The present contribution deals rather with the wider geological point at issue.

In dealing with ore deposits as they were chiefly known previous to the discovery of the Rand, it was only natural for the theorists to come to the conclusion that veins and fissures would be found to be poorer the deeper they were opened up, because, until the comparatively recent intense search for valuable minerals throughout the world, the majority of the deposits which had been worked were, by reason of the greater ease of their selection, in that particular class which affords the evidence in support of the formation of a theory on these lines.

All mineral deposits have limits to their extent both laterally and vertically, and, in the cases where the valuable mineral has been introduced upwards from below, the vertical length of each lens naturally tends to be greater than the lateral extension. I use the word "lens" advisedly, for in the succeeding argument all deposits which have defined limits and defined thickness may be considered as variations of lens-formation when spoken of broadly as regards their mass. In the natural process of denudation of the surface, these lenses are weathered down together with the surrounding country, and it is when their greatest thickness—and therefore their most important horizon—is reached that they offer more resistance to the denuding influences than does the country rock, and so stand up above the normal surface, thereby offering easy evidence to the prospector. This evidence is often supplemented by a large amount of surrounding detritus, being the product of denudation. If it happens that the thickest portion of the mass has not yet been brought to the surface horizon, subsequent mining operations will, in time, pass through it, and will thereafter continue down into the narrower portions of the lens until that particular deposit pans out.

That is the type of mineral deposit which, till recent years, has formed the subject of the mining operations in the majority of vertical and inclined veins and lenses of the world. Other deposits there are on which denudation has done its entire work, and, when the rich material on the surface which still remains in concrete form in large blocks has been cleared up, the underlying country has been found to contain the merest stringers of what was, in the higher levels, a magnificent deposit A vast field yet remains for future generations who will be equipped with appliances for detection, the nature of which are only now dimly indicated by embryonic investigations in the science. Further developments will provide the means to find those lenses which either give no indication of their contents on the surface at all or present so insignificant an outcrop in size and value that they are to-day left untouched. This may be taken to apply to the type of ore deposits that have until recent times formed the chief sources of production. The field is now so vastly widened that it is necessary to review the position afresh and to be prepared to discard many of the theories which have of necessity only been formed on one section alone of the mineral wealth of the world.

I have pointed out that the majority of the evidence of decrease of value in depth has been taken from those deposits in which the measurement has been greater in their vertical than in their horizontal axis. Let us now take a broad view of the Rand deposit as seen from the standpoint of nature, regardless of the many small readings with which it has been burdened, based on the comparatively small and haphazard disclosures made by human agency.

Between the extremities of Randfontein and Modderfontein there are about fifty miles of banket, which can

MINING IN PICTURE



Alluvial Gold Workings in the Transvaal. Sluice Boxes of Metlepitsi Alluvial Syndicate

Rand Mining in Picture



Views at the Crown Mines

be considered from a natural standpoint as one continuous and systematic gold-bearing deposit. Take the present developed depth of the Rand, say five thousand feet vertical or ten thousand feet on the dip, and study the formation diagrammatically by drawing a rectangle with the horizontal side to represent fifty miles in length and the vertical side to represent five, ten, or, if you wish to look far into the future, twenty thousand feet on the incline. In each one of these cases you will obtain a representation that will show far less depth in proportion to the length than is the case between any two levels in any average mine in the normal type of ore deposit. From the point of view of nature, this is one great gold deposit, and it is altogether unreasonable to suppose that the purely fortuitious position of the outcrop horizon, embracing a strip of ground almost of length without breadth, was selected by the various agencies responsible for the deposition of the gold in direct opposition to all the observed procedure in other mineral deposits of the world. Whether the gold came in with the pebbles from above downwards, or from below along the plane of least resistance upwards, or whether it filtered in from the great mass of the surrounding country and found a final resting place in concentrated form in the conglomerate, one thing is certain, that there is no argument that can support the theory that nature has chosen a strip fifty miles horizontal by two miles on the incline, to the exclusion of the remainder of the great stretches of the banket deposit throughout the Witwatersrand series, or, to bring it within practical limits, to the exclusion of the next two miles southwards on the incline. That the weathering away of the surface from unknown heights to the level of the present outcrop has taken place is evidenced by the rich deposits of gold which occurred in the oxidized zone in the vicinity of the surface in the higher grade sections and has been worked out in the early days of the more notable mines. The gold so deposited can have been but a small portion of that which was originally contained in the subsequently denuded banket, but the amount found redeposited in sub-outcrops of the reefs *in situ* shows that the formation must have been subjected to denudation to the extent of thousands of feet.

As regards the variability of gold content in detail, it is not possible to give any rule for the mode of accretion of what is locally termed the "payable" as against the "unpayable" portion of the deposits. The most that can be said is that the consistently richer portions lie in series of irregularly-shaped areas of which the units can be observed as measuring roughly up to five thousand feet by two thousand five hundred feet on their major and minor axes. There is an indication that evidence will be forthcoming, as the development of the country progresses, that these richer areas form links in a series of huge zone formations, which wind about without limitation of horizon through the great mass of the Witwatersrand beds. The mine development to-day is the greatest where these zones have been bisected by the line of outcrop.

To revert for a moment to the comparison usually made between present results and those of former years and to show how fallacious as a means of argument is the hitherto commonly accepted basis of yield, I will quote one instance where I have made a comparison on a comprehensive scale between the records of the old workings near the surface and those now being prosecuted at the greater depths. The assay values of the tonnage measured over the stope widths stand in the records of the old workings in the upper levels over the various sections of country as 9.7 dwts. over five feet, 17.3 dwts. over four feet six inches, and 10.9 dwts. over four feet six inches. When removed from their richly endowed home in the narrower stoping width that used to be considered sufficient for the moderate ideas and small mills of the early days and translated into figures distributed over the actual stoping widths from which the ore is extracted by the present methods, the above records taken in their due proportion are represented as 8.8 dwts. over six feet six inches, and when compared on a common basis, there is only the difference of a fifth of a pennyweight between the two periods.

There is yet much ore rich in gold-content to be found in the unprobed depths of the Witwatersrand, but to be a profit-producer it must, when found, be treated as nature has made it, and be extracted by methods of mining which will enable it to give the full force of its value in the mills in which it is treated. In the meantime, judging the Rand from a comprehensive standpoint, the deepest-level work is merely prospecting, and it will not be until the now opened up deeper developments of to-day have been extended throughout their horizon so as to form connecting links in the chain of evidence at the depth of the present deepest line of shafts that we shall be able to select with some degree of accuracy those sections of the Main Reef series which will be, in the depths yet unexplored, the successors to the rich producers at the outcrop.

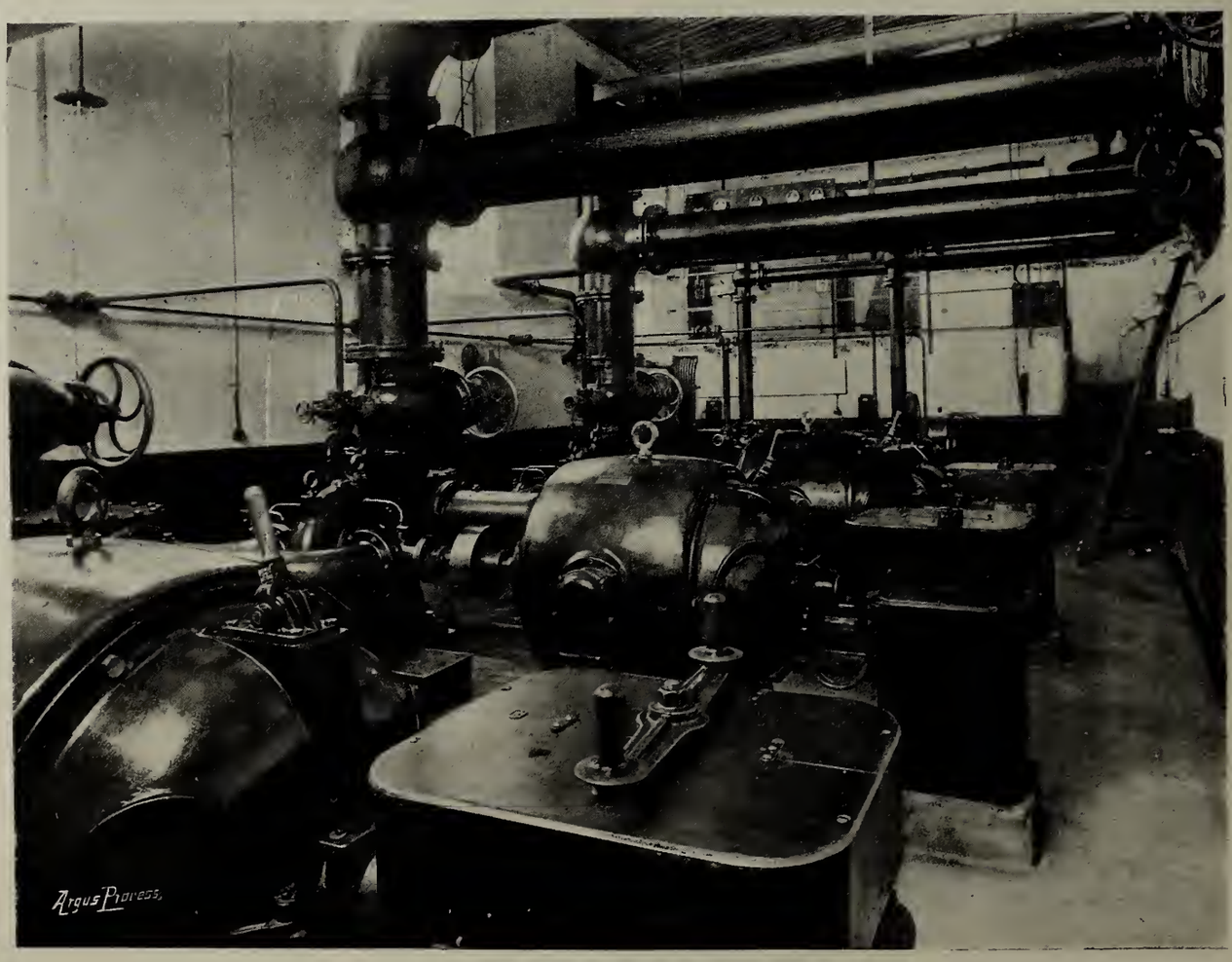


Air Compressor Station, Victoria Falls and Transvaal Power Company

Rand Power Supply



Turbo-Compressor Room



Pump Installation for Inter-coolers.
Robinson Central Turbo-Compressor Station, Victoria Falls and Transvaal Power Company, Limited

The Story of the Johannesburg Stock Exchange

By Colonel R. A. BETTINGTON

Missing Records.

I SOMEWHAT gaily and heedlessly undertook the task which was suggested to me of writing the above story. It was merely looking up a few of the earlier data and refreshing my memory with certain references. For was not the story of the Stock Exchange the story of Johannesburg, leaving out a few of the threadbare pioneer anecdotes of tent dwellings and collapsible mud-built houses?

Strange to say, however, that notwithstanding all the assistance of my friend Mr. Hilner, of the Estate Company, no records earlier than the minute book of 1888 could be found, commencing on the 17th August with an entry stating that the minutes of the previous meeting had been read and confirmed and the case of Bettington versus R. Woolf postponed.

Original Members.

An old ledger was found dating from October, 1887, with the names of one hundred and twenty-two original members :—

Abrahamson and Co., A. D. Alexander, J. A. Audrey, R. Allen, R. F. Bertram, F. H. Barber, J. Birbeck, F. Thorpe Becker, J. L. Bussey, Abe Bailey, A. E. Beckmann, N. Bock, C. A. Brown, A. L. Brink, J. Butler, Chas. Cowen, R. H. Cooke, Louis Cohen, H. Currey, F. Churchill, J. Carlisle, Driver and Co., J. N. de Villiers, J. Durham, Mones Davies, J. W. Dold, H. David, J. W. Dallamore, Alf Dowling, H. Eckstein, W. E. Eastwood, H. Ende, F. English, — Elkan, G. B. Fyfe, A. W. Fuller, W. P. Fraser, J. Frank, A. W. Francis, F. M. Faulkner, A. Goldberg, J. Gardner, Fred Gray, W. Goddard, E. C. Garisch, G. H. Goch, J. E. Green, J. Hepburn, P. Henwood, C. Hanau, H. T. B. Harrington, Alf Hart, C. Hoffmann, J. S. Harrison, E. Hancock, E Jones, C. Jeppe, Jones and Laurence, G. A. Jones, R. F. Jones, H. C. Johnston, A. Kauffmann, O. P. Koch, S. Kling, J. W. Kenyon, G. P. Lofthouse, J. J. Lithauer, J. Lang, E. Lippert, J. Levinson, A. L. Lawley, H. Molineux, W. F. Morris, S. Moritz, J. C. Milbourne, H. Mitchell, M. Meyers, J. E. Mears, F. Mosenthal, J. Mackilligan, — McBride, McLea and Rush, W. H. Norton, A. V. H. Peacock, W. Perks, S. Papenfus, J. Pascoe, Payne and Trull, J. Radford, R. G. Rimer, B. Ryan, D. P. Ross, H. A. Rogers, J. Reid, — Rance, R. C. Stroyan, F. L. Shuter, J. Stroyan, W. A. Stilwell, — Warre-Smith, H. Scholtz, C. W. Southern, S. Sacke, R. S. Shaw, T. Y. Sherwell, G. Saunders, J. L. Tollemache, W. P. Taylor, J. B. Taylor, G. A. Tilney, P. Thomson, C. Watson, J. Wolhuter, E. H. Wardle, E. Wicke, Wehl and Hartog, J. Welch, W. D. Wright, B M. Woollan, S. J. Wilks, H. S. Williams, D. Ziman.

Of these the following alone remain: J. Birbeck, Abe Bailey, A. E. Beckmann, Mones Davies, W. J. Dold, A. Goldring, C. Hanau, H. T. B. Harrington, J. S. Harrison, G. A. Jones, E. Lippert, Albert Levy, J. Mackilligan, R. G. Rimer, H. A. Rogers, S. Sacke, W. P. Taylor, Colin Watson, S. J. Wilks, and D. Ziman.

First Prospectus.

A further search through the Stock Exchange books produced a copy of the "Local Diary for the year 1888," compiled by B M. Woollan and Co., and published in 1887 by the Argus Company of Capetown. Therein appears a sort of prospectus of the Johannesburg Exchange and Chambers Company, Limited. Capital, £5,000 in £1 shares. Directors: T. G. Lawrence, M.D., James Lang, Frederick Gray, James B. Taylor, J. L. Busse, T. P. O'Meara, M.L.A., Natal: Chairman: Benjamin M. Woollan. Committee: Lawrence, Taylor, Busse, W. J. Quin, E. Hancock, and C. Hanau.

Autocratic Control.

Then follows "The Johannesburg Stock Exchange." Proprietors: The Johannesburg Exchange and Chambers Company. Sixty-nine rules signed by B. M. Woollan, of which No. 13 is worth recording as showing the state of subserviency to the parent company to which ordinary members submitted.

Rule 13. The Directors reserve to themselves the right to alter, repeal, amend, or make any additions to the tariff of charges, and rules and regulations of the company as they may think from time to time.

Rule 8 provided that the Chairman of Directors and the Secretary for the time being of the said company, *i.e.*, the Exchange and Chambers Company, shall *ex*

RAND MINING IN PICTURE



Angelo Shaft, E.R.P. Mines

Rand Mining in Picture

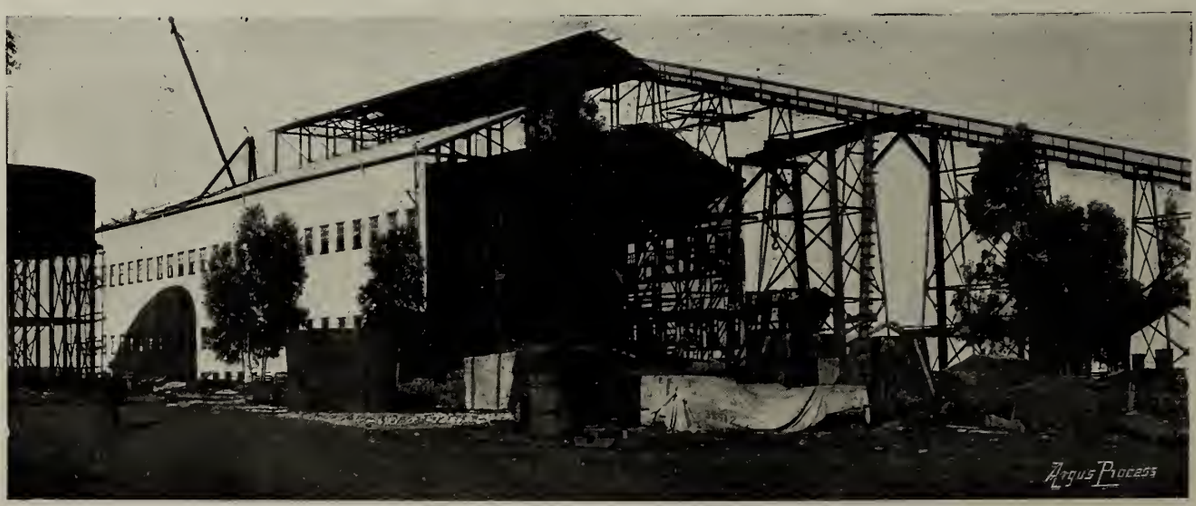
CENTRAL MINING AND INVESTMENT GROUP



Modder B. Surface Plant in Course of Erection



Bantjes Consolidated A Surface View



Modder B. The Battery

officio be the Chairman and Secretary of the said committee. Thus it will be seen that the original Stock Exchange was instituted as a milch cow for the Exchange and Chambers Company.

Woollan Inventit.

It appears fairly certain that the two above institutions were the offspring of the fertile brain of Mr. B. M. Woollan. The original members of the Stock Exchange became foundation members of the subsidiary institution on payment of £10, and for a brief period appear to have paid a quarterly subscription of £1 11s. 6d. as against the £3 3s. of ordinary members.

Profitable Promotion.

The business was certainly profitable to the parent company, as it received all the entrance fees and subscriptions, the members of the Stock Exchange obtaining only the right to buy and sell shares under regulations over which they had no control. Each broker had to find personal security for £250 and another security for a like amount.

A Moral Standard.

Before passing on further, it may be of interest to note a sort of appendix supplied by the conscientious Woollan on "Basis of Values." The writer is evidently anxious to safeguard a somewhat—even in those early days—gullible public, who might be deluded into entering upon unsound investments on the strength of alluring prospectuses. Thus: "With a view to check as much as necessary undue inflation or depression in the share market, we venture to give an instance of actual values, and, to prevent unpleasantness, forbear to mention any particular company from which such is taken."

Then come details of which the following extracts will suffice: Capital, £120,000; yield at one ounce per ton, 14,250 ounces at 70s., £49,875; Expenditure, annual, £29,875;. balance, £20,000.

"We hold that mining risks should bear 25 per cent., on which basis the shares of above company are not worth par, as it can only pay 16 per cent. The shares of this company reached 30s. before the battery was started."

My readers can doubtless supply their own comments without assistance of mine!

Aristocratic Secretary.

The first secretary of the dual institution appears to have been the late Sir Drummond M. Dunbar, Bart., a gentleman of ancient descent and of modest, retiring manners, qualifications which would hardly entitle him to aspire to such exalted rank at the present day.

Enter Barney.

The B. M. Woollan venture apparently flourished for about a year, until some time in 1888, when the still more versatile Barney cast his eye upon the new promised land and found it to his liking. It did not take him long to ascertain that besides actual mining ventures and company flotations, there was good stuff being wasted by the Exchange and Chambers Company for want of intelligent handling and proper administration.

Mere Presumption.

Records state nothing, but presumption is strong to the effect that operations for shifting the responsibility of B. M. Woollan's philanthropic scheme on to his own shoulders commenced with what may be called the burrowing process, *i.e.*, quietly buying up proprietary members' shares at as small a premium as possible, and then convening a meeting of shareholders at which the advantages of the new scheme was set forth in eloquent, if somewhat guttural, terms. The result of the meeting was, naturally, a foregone conclusion, for, notwithstanding the strong protest of a minority, a sufficient number of shares had been obtained to secure a favourable vote.

Barney in Excelsis.

Thus Barney and Co. became for several years the dominant factors of the Stock Exchange. At that time the members seem to have been a turbulent class, and the records are teeming with complaints of personal disputes. Barney himself is reported as being one of the parties to a quarrel of so violent a nature that it was noted by the committee, but so great was his influence that an attempt was made to hush up the matter. The members, however, made so loud a protest that the hands of the committee were forced. The autocrat had his own way, more or less, for though obliged to send in a written apology, the committee decided that it would be sufficient to notify the members that their meeting of protest was uncalled for, as Mr. Barnato and his adversary had apologised, but that the apology should not be read. Two days previously a couple of unfortunate ordinary members had been expelled for "contravening the rules."

A Profitable Committee.

The committee was reaping a rich harvest from hearing fees amounting to five guineas a time, which amounts they divided between themselves. The value of a seat may be estimated from the fact that on the 19th February, 1889, no less than eighteen cases came on for hearing.

Big Prices.

These were the days of big business and big prices. Dealers thought nothing of handling twenty thousand shares at a time, and the amount of money involved may be gathered from the record of a dispute concerning fifteen hundred Worcesters at £18 and another over Chimes at £5 2s. 6d.

RAND MINING IN PICTURE



Main Reef West, West Shaft

Rand Mining in Picture

CENTRAL MINING AND INVESTMENT GROUP *(Continued)*



Crown Mines Cooler



City Deep Sands Plant and Residue Conveyor



South Rand Shaft, Crown Mines

Limitation of Membership.

On the 20th of February, 1889, the membership had increased to such an extent that it was decided, *pro tem*, to accept no further applications.

New Building Scheme.

The old building was proving inadequate, and the Estate Company decided to acquire the land on which the buildings, now about to be demolished, still stand facing Commissioner Street and the Eckstein and National Bank block. With this end in view, a curt notice was issued to the effect that the quarterly subscriptions were to be doubled, *i.e.*, from £3 3s. to £6 6s. An attempt was made to get up a protest, but the bulk of the members, bent on money-making, were too indifferent or too timid to face the redoubtable Barney.

Barney Challenged.

At last one individual, with more recklessness than discretion, ascended the rostrum after high 'change and harangued the members on the unjustifiable policy of making them pay in advance for work which had not even been commenced. This brought Barney, in turn, on to the rostrum, where he held forth at length in a speech breathing money and its influence in every word. The reply was brief. "According to Mr. Barnato, honesty, a good name, and an unblemished record are to count for nothing against the mere possession of money. Can, then, any blackguard possessing £100,000 claim membership of this Exchange as a right?" Such plain speaking could not be passed over unchallenged, the more as the local artist of the day reproduced the incident in a clever sketch!

Sweet Revenge.

The would-be reformer found the doors closed in his face the next morning on the technical grounds that the committee had decided to transfer his ex officio ticket to his successor, which request they had previously absolutely refused.

First Fruits of the Struggle.

However, some good came to the members from the movement. The reformer was re-admitted in a week, and set to work to form a committee of eighteen to resist the Barnato encroachments. Needless to say, pressure was brought to bear in the usual way, and at the last five only were found to have stood firm; yet, so far had opinion been swayed, that the old committee was forced to retire and a new one elected by ballot, and as a further concession the Estate Company left the entire control of the Exchange in the hands of the committee, while retaining for themselves the whole of the revenue. Mr. James Hay was appointed as the first independent chairman. The foundation stone of the new building was laid on the 2nd November, 1889, Messrs. Lennon, Canning and Goad being the architects.

New Hall Opened.

The new hall was opened on the 10th February, 1890. In those days building material was of inferior quality, notably bricks, while stone was hardly procurable, Consequently the best of designs could not be adequately carried out, yet the hall was thoroughly artistic and perfectly adapted to the purpose for which it was built. It was not till the 6th January, 1891, that the extortionate hearing fee of £5 5s. was reduced to £2 2s., at which figure it has stood ever since. At the same time the subscription was brought back to its normal figure of £3 3s.

The First Slump.

In this same year, 1891, came the first slump, which was truly of a disastrous character. The leading firm of brokers, who in the previous boom were credited with having made as much as £300 a day, failed hopelessly, through wild speculations, the most disastrous of which arose from bearing Barnato stocks—the cost of that one venture amounting to £45,000. The mines had been shockingly mismanaged and most extravagantly worked, and despondent pessimists declared that the reef would come to an end as a payable proposition at a depth of between sixty and a hundred feet. Some idea of the shrinkage of business may be gained from the fact that the hearing fees for the half-year ending 31st December, 1891, amounted to only £14 14s., which sum was divided between the Hospital and the Public Library.

First Closing.

The Exchange was closed for the first time since its inception on the 12th January, 1892, for the funeral of the Duke of Clarence. Old inhabitants may still remember the feelings of bitter anger that were roused at the time by certain scurrilous newspaper articles entitled the "Dying Duke" and the "Dead Duke," and nowhere was indignation more strongly displayed than on the Stock Exchange.

The President Visits Johannesburg.

The 15th of March, 1892, was another "first occasion," when Mr. F. Mosenthal was appointed as a representative on President Kruger's visit to the town.

RAND MINING IN PICTURE



Sorting and Crusher Station, South Rand Shaft, Crown Mines

Rand Mining in Picture

CENTRAL MINING AND INVESTMENT GROUP *(Continued)*



Crown Mines South Rand Sorting and Crusher Station under Construction



Bantjes Consolidated Surface Works



Robinson Gold Mining Company Battery

Indecent Hilarity.

In July, the minutes of the day solemnly record the censure of members for bringing a piano into the house during business hours, hilarity of any kind being presumably considered out of place during a slump. On the 1st of September, 1892, a law was passed compelling the stamping of brokers' notes.

Another Step towards Emancipation.

In November of the same year a further step towards emancipation was gained, the directors and their alternates of the Estate Company, who had hitherto claimed the right of entry, being refused admission unless they happened to be members.

Death of Mr. H. Eckstein.

The second official closing was on the 19th January, 1893, the date of Mr. H. Eckstein's funeral in Germany.

A Notable Date.

The 28th of August, 1893, was a somewhat notable date, as thereon a general meeting of members was held at which a resolution was passed to the effect "That, in view of the refusal of the Estate Company to entertain any proposal for the modification of the present contract with the members of the Stock Exchange, it be an instruction to the committee to commence immediate negotiations for the lease of suitable premises as near the present buildings as possible, and to be ready for occupation at the termination of the present lease."

The Estate Company Pharaoh, as might have been expected, hardened his heart, and it was only after months of fruitless discussion, during which the attempt was made to induce the company to accept a landlord and tenant contract, that the old contract was provisionally renewed for six months from January, 1894.

A Memorable Year.

The year 1894 was memorable in more ways than one. Firstly, for the recovery of the industry and the improvement in business which led to the great boom of 1895. Secondly, for the shortsighted folly of the committee that allowed itself to be bluffed by a certain specious and prejudiced individual into refusing an official quotation for the Rand Mines, Ltd., on the ground that, according to the rules of the Exchange governing the quotation of companies, sufficient working capital had not been subscribed. This insensate proceeding forced the whole business of the leading gold stock to London, and incidentally had a most detrimental influence on local business ever after. Thirdly, a climax was nearly reached between the Estate Company and members when, in June, at a general meeting, one hundred and twenty members, as against fifty-six, were induced to pass a resolution instructing the committee to make the best possible terms with the Estate Company. All the committee resigned except the chairman for the time being, who considered that he was bound to be guided by the vote of the members.

A Memory of the Past.

In October, 1894, Vaughan, the door-keeper died. He was quite a character in his way, and no one ever could have guessed from his appearance that he was the brother of the beautiful and celebrated Kate Vaughan, who also died some years ago in Johannesburg in poverty. I happened to be visiting the old cemetery the other day, and though the following does not concern the Stock Exchange, I cannot resist paying a passing tribute to the members of the stage who have visited this town from time to time, for it can only be due to them that the late actress' grave is at the present day most beautifully kept up.

First Deputy-Chairman.

At the committee election in 1895 a deputy-chairman was appointed for the first time, Mr. Gustav Imroth being elected. On the 3rd July, the chairman of the committee was invited to attend the functions of the 8th and 9th at the opening of the Delagoa Bay railway.

Bulawayo Comes In.

On the 3rd September, Bulawayo wired announcing the holding of their first High 'Change. In October the highest security ever demanded, *i.e.*, £5,000, was lodged by a certain member, which amount was justified seeing that he failed not long after.

Echo of the Raid.

On the 24th December, the first echo of the Raid was heard, the committee's attention being drawn to a political harangue delivered from the rostrum by Messrs. Berlein and Albu. Events hastened rapidly from then on, many members of the Exchange being involved as members of the Reform Committee, or on what might be called active service. Business must have come to a standstill at the turn of the year, for on the 2nd January, 1896, it was resolved: "That in the present condition of public affairs the two next days be declared holidays." The consequences of the Raid and the arrest of so many financiers and dealers, with the interdiction of scrip and banking accounts, raised unexpected difficulties, and the chairman had to proceed to Pretoria to interview the State Attorney in regard to the interdicted scrip.

Sympathetic Closing.

On the 24th of April, by the unanimous vote of the members, the House was closed as a mark of sympathy to the Reform Committee in view of the heavy sentences passed upon them.

Generosity of Members.

The generosity of the members was never more strikingly shown than at this time. They vied with one another in trying to assist their fellows in their trouble. They came to Pretoria daily to bring comforts to the gaolbirds. Barney had a special coat made reaching to his heels, with over twenty pockets, each filled with flasks, cigars, and cigarettes. "Stand round me, boys, so that they can't see, and pick my pockets." H. J. King refused to leave Pretoria until the last man was out. They visited the wives of the prisoners and tendered assistance with every kindness and delicacy, and in one instance, if not more, they were prepared to pay the entire cost of the fines. And this, it must be remembered, for the sake of men with whom the

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RAND MINING IN PICTURE



Rock Crushing Station, Crown Mines

Rand Mining in Picture

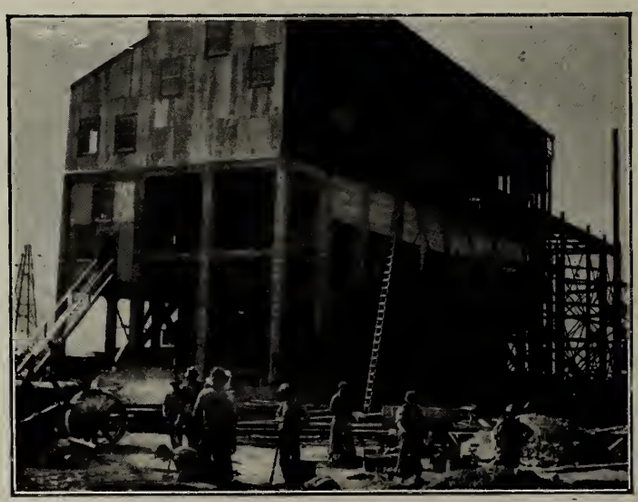
CENTRAL MINING AND INVESTMENT GROUP *(Continued)*



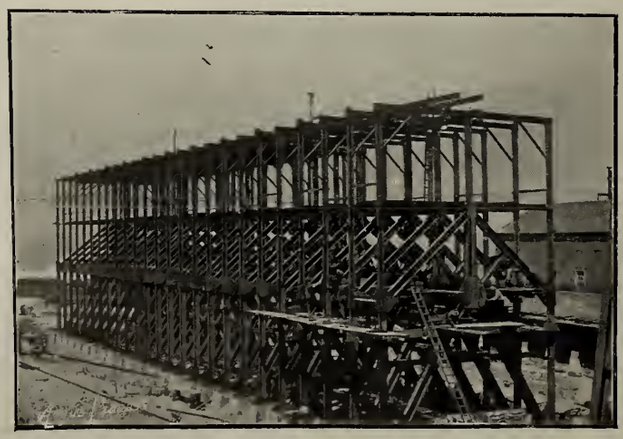
South Rand Shaft and Crusher Station under Construction, Crown Mines



West Shaft Headgear, Crown Mines



South Rand Crusher Station under Construction, Crown Mines





Crown Mines New Mill in Course of Construction

majority had no political sympathy, and whose conduct had cost every member of the Exchange, together with their clients, enormous losses. The committee furthermore cabled to the London Stock Exchange inviting their good offices to plead for a mitigation of the sentences. The 30th of May was a day of rejoicing. A special meeting of members was held, and the following telegram was sent to President Kruger.

Telegram to the President.

"At an enthusiastic meeting of the members of the Johannesburg Stock Exchange, held immediately on receipt of the decision of the Hon. the Executive Council, it was unanimously resolved to convey to your Honour and the Honorable the Executive Council their warmest and heartiest expression of thanks for your magnanimous and generous decision in regard to the release of the Reform prisoners. Your decision cannot but have the most beneficial and far-reaching effects upon the whole of South Africa, and the members feel sure that the same magnanimity which prompted your action will be extended to those still under sentence." The rest of the year brought forth nothing of interest.

First East Rand Disaster.

On the 13th May, 1897, came the East Rand disaster. Heavy bear attacks brought the stock down to 28s. 6d. Retribution followed, and as usual the innocent suffered. So serious was the position that members petitioned the committee to formulate some plan of relief, but were advised to thrash the matter out themselves. Finally, the make-up price was fixed at 65s., and seven members failed.

Commencement of Final Fight with Estate Company.

In June, the final fight with the Estate Company commenced. Another effort had been made to obtain a landlord and tenant agreement, when the company demanded £5,000 a year rent, the Exchange to receive the revenue from entrance fees and subscriptions. At a general meeting of members and a subsequent poll, when one hundred and eighty voted for and ten against, it was resolved to offer the Estate Company £2,500 a year, failing acceptance, arrangements to be made for premises elsewhere. During the progress of the pool a protest was handed to the chairman, signed by eleven members.

Desperate Measures.

A provisional interdict had also been obtained, at the instance of one of the nominees, from the Special Judicial Commissioner of the Witwatersrand Gold Fields restraining the committee from proceeding with the voting, from acting in accordance with the said voting, or from dealing with the funds. The chairman stated that the interdict had been served after the voting had been taken, with the exception of one vote, which had not been recorded. Resolved that the Estate Company be informed that, in consequence, no further steps would be taken till the 30th of June, when the agreement expired, and that then the premises would be vacated. Counsel was retained to obtain removal of the interdict. The interdict was dismissed with costs a few days later, and the Estate Company gave notice of appeal. A final settlement with the Estate Company was arrived at on the basis of a five years' lease at £3,000 a year, with right of renewal.

Death of Mr. Barnato.

On the 13th of June, the death of Mr. B. I. Barnato was reported, and the Exchange closed for the remainder of the day.

Proprietary Membership Instituted.

On the 9th November, 1897, a scheme which had been brought forward some months before for the establishment of proprietary membership was passed. These rights were first sold at £20 each, and subsequently rose to £500.

Opening of Bulawayo Railway.

The Bulawayo railway was opened on the 4th November, at which Sir Arthur Lawley made his famous speech. The committee received the usual invitations.

Wave of Piety.

On the 31st of January, 1899, a wave of piety appears to have spread over the committee, for Sunday dealing had become such a scandal that the Commissioner of Police was requested to intervene. On the 31st March, 1899, the official time was put forward half an hour.

Slippery Brokers.

In April the authorities discovered that a good many brokers had evaded the law enforcing the stamping of notes, and on the 27th a police raid was made on books and papers for the purpose of getting at the defaulters. Serious trouble might have ensued had it not been for the friendly spirit displayed by the Public Prosecutor, Dr. Krause, who received a deputation from the committee and agreed not to prosecute in consideration of the committee's guarantee to make all notes good.

In August, the committee made an offer of £17,500 for the stands now used for Richard Currie's Tattersalls

RAND MINING IN PICTURE



Rand Co-operative Smelting Works on the Robinson Mine

Rand Mining in Picture

CENTRAL MINING AND INVESTMENT GROUP *(Continued)*



Compressor Station, New Modderfontein



Crusher Station, Western Shaft, Crown Mines



Bantjes Consolidated Mines The Main Incline Shaft

sales, but the Gold Fields refused to consider anything under £25,000.

Rumours of War.

September brought anticipations of war, and the opinion of Dr. Farrelly, who was considered a great authority on international law, was taken in regard to a moratorium. The Exchanges of Capetown and Maritzburg came forward with offers to facilitate the carrying on of business in the event of the local Exchange having to be closed.

Loyalty of Berlandina.

The committee, in very reduced numbers, met for the last time on the 3rd of October, and decided to close the building. The following resolution was passed: "That a cordial vote of thanks be accorded to the deputy-chairman, Mr. E. E. Berlandina, for the manful way in which he had stuck to his post during the crisis." These minutes were confirmed on the 24th December, 1901.

The War Period.

During the war the Exchange was well represented in the various irregular corps, and paid toll for their patriotism, as witness the brass memorial to be seen in the hall. The more peaceful or pecuniarily inclined appear to have done a good business in Capetown and Maritzburg, which was of material assistance to them on their return to Johannesburg, while the unfortunate contingent who preferred active service found themselves left in the cold through loss of clients and being generally out of touch with business.

Re-opening of the Exchange.

On the re-opening of business in December, 1901, the committee found itself with a cash balance of £21,000, and immediately set to work for the purpose of securing an option on the block of stands on which the present building was subsequently erected.

Failure to Purchase Building.

Before proceeding with the purchase of the new block, another attempt was made to secure the old building, but the price demanded by the Estate Company, of £200,000, was considered prohibitive, seeing that in addition to that sum considerable further expenditure would be required for rebuilding.

New Stands Purchased.

The Sigma block was then purchased for £22,750, and Sauer Street continued past the present western frontage, for which the company made a proportionate allowance.

Death of Cecil Rhodes.

Business had hardly got well under way again when the death of Cecil Rhodes was announced, the hall being closed for his funeral on the 10th April, 1902. On the 17th July the irritating censorship of telegrams, except Press ones, was abolished.

Chamberlain's Visit.

The last function of importance held in the old building was the reception of Mr. Chamberlain, on which historic occasion the hall and galleries were packed mainly with the wives and relatives of members.

Foundation Stone Laid.

On the 6th of April, 1903, the foundation stone of the new building was laid by Lord Milner with considerable ceremony. In July the footrace to Pretoria took place and the prizes were presented by the High Commissioner.

The Committee Sued.

In August an important action was commenced in the High Court by an expelled member, who claimed £10,000 for wrongful dismissal. The action of the committee was upheld, with costs, which meant a considerable cash outlay, seeing that the plaintiff had nothing.

Chinese Labour.

In December, 1903, the shortage of Kaffirs on the mines brought up the question of imported coloured labour. The project was unanimously supported at a general meeting of members.

Occupation of New Building.

The new building was occupied in January, 1904, but not completed till some months later, the total cost being £123,000 in addition to the land.

Benevolent Fund Instituted.

In August, 1905, a suggestion was made to the committee to institute a benevolent fund for the benefit of distressed members, widows, and orphans on the lines long in vogue at the London Stock Exchange.

Deaths of Mr. James Hay and Mr. Alfred Beit.

On the 12th of December the Exchange was again closed for the funeral of Mr. James Hay, the first independent chairman of committee; and again on the 19th of July, 1906, for the funeral of Mr. Alfred Beit.

White Labour Attempted.

In August, 1907, the local distress being so great, an attempt was made to employ white labour all over the house, and the efficient coloured boys were dismissed. Although the greatest care was taken in the choice of their white substitutes, the experiment, unfortunately, proved a hopeless failure, and a return to the old system was very soon necessitated.

Proprietary Club.

A further attempt was made in November to improve the position of members by the formation of a proprietary club on the model of the Adelaide Stock Exchange in Australia, where it proved a great success. Local conditions, however, proved different, and the attempt had to be abandoned.

The two next years passed without any incident worth recording beyond the fact that the general depression became accentuated.

Visit of the Duke of Connaught.

In April, 1910, the Duke of Connaught visited Johannesburg, but the committee took no part in the official proceedings, and His Royal Highness owes them a debt of gratitude for abstaining from presenting him with an additional futile address.

Death of the King.

The Royal visit was shortly followed by the lamented death of King Edward VII. on the 1st of May, when the



Fighting Malaria.- Mosquito Cage, Onderstepoort Experimental Station

Rand Mining in Picture

ANGLO-FRENCH GROUP



Mortar Box Foundations and Concrete Columns to support Ore Bins, Benoni



The New Benoni Mill

Exchange closed and went into mourning. A cable of condolence was sent to Queen Alexandra, and a most gracious reply duly received.

Good-bye Power.

On the 31st December, 1911, Mr. Charles Power, a most efficient and popular secretary, retired after many years' service for the purpose of farming in Natal. The present year has so far brought forth nothing new with the exception of the East Rand fiasco, which, fortunately, was not so disastrous to members as the one previously recorded.

Flotation of Wild Cats and Syndicates.

I have not mentioned the flotation of companies, because to attempt even a modest list of all the wild-cat ventures, with their inflated prices and hopeless collapse, would fill a small volume. The tragedy of one well-known venture which spelt ruin to thousands and the death of the chief promoter, has not yet been forgotten. The final blow which drove him to take his own life is said to have been the receipt of a parcel containing a woman's shift with a piece of paper inscribed with the words: "All I have left, you have taken the rest." On the other hand, many thousands were sunk in syndicates, at one time a favourite method of modest gambling. Prospects were often sound, but almost invariably failure ensued from the inability to hold on long enough and pay licences. One noteworthy case was the Deep Kloof Syndicate, which had to liquidate for the want of £250. To-day the property would be deemed cheap at a million or more.

Disappointing Series.

The Nigel series and the Black Reef series were highly thought of in the early nineties. The assays were exceptionally good, but the reefs pinched out in the first instance and flattened in the second. The last attempt to resuscitate a Black Reef property was with the Midas Deep, where extravagant reports sent the stock to over 30s., which to-day is valued at exactly sixpence. Since this was written, the company has gone into liquidation, and it is anticipated that not even the afore-mentioned sixpence will be forthcoming. The Coronation Syndicate proved another ghastly fiasco, the £100 shares rising to £2,800 and falling to practically nothing when the property had been carefully examined and reported upon by a competent and incorruptible expert.

Working the Market.

How the market was worked for worthless ventures merits some mention. At first the local soil used to be carefully tilled, sown, and watered, but in time, the unfruitfulness of the seed being realised, it was necessary to go further afield. Communication with the coast towns was naturally restricted in the days of lengthy and expensive postcart journeys, so the visit of some known Johannesburger was a noteworthy event at any of the lesser ports.

Health Trips to the Coast.

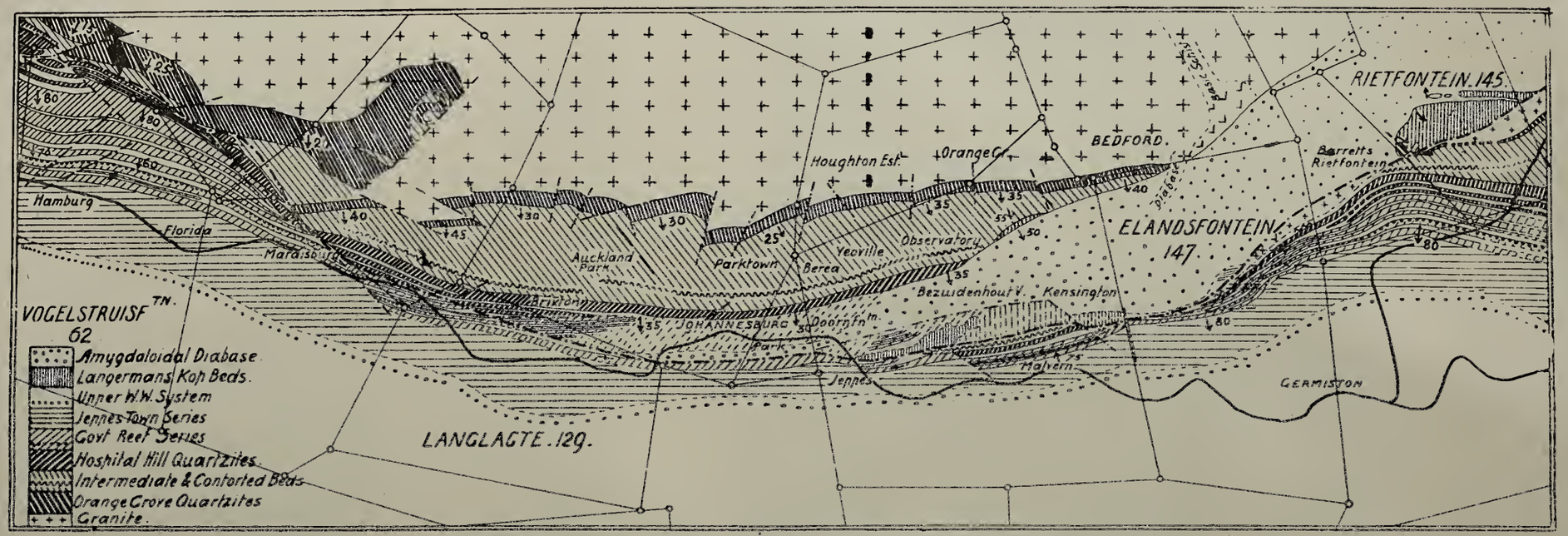
On one occasion a weary traveller descended at—no matter where. He was promptly recognised and besieged by eager enquirers. Jovial and lavish with liquid refreshments, he was seldom without a crowd of disinterested well-wishers on the hotel verandah. Enquiries after mutual friends were followed by natural questions as to investments. To the first he readily responded, and was never tired of recounting how old Joe this was getting on, and what old Jim that was doing. As to business, however, he was close as an oyster. "No shop, no financial discussions. He had come down for a rest from all that sort of thing and to see old friends." But surely he could give them a tip, as they were so apt to be misled by interested information. No, he was giving no tips. He was trying to forget there were such things as mines and shares. They had their own brokers. He was not to be bothered. At last, driven to despair by endless worrying, he lets out to one of his oldest pals, coupled with the wish that his persecutor might be consigned to the flames of Tophet, that, if peace must be purchased, it can be done by an investment in the "Fool Struisfontein United." Would he order some shares at once for his friends? No, he wouldn't. More despair. How were they to be obtained? More bad language and infernal consignments. At last! Wire to Footle and Co., Johannesburg, and be d——d. Shortly afterwards an urgent telegram recalls the neurotic financier from the Elysian fields of the coast back to his sordid surroundings in Johannesburg, and he returns to gather the golden sheaves into his barn. The next comparatively honest and harmless visitor from the north is promptly bombarded with enquiries as to the prospects of the supposed El Dorado. "That rubbish. I always wondered how it got floated. We wouldn't touch it with a pitchfork up there. Smifkins gave you the tip!"—and a prolonged

A HISTORIC RAND FUNCTION

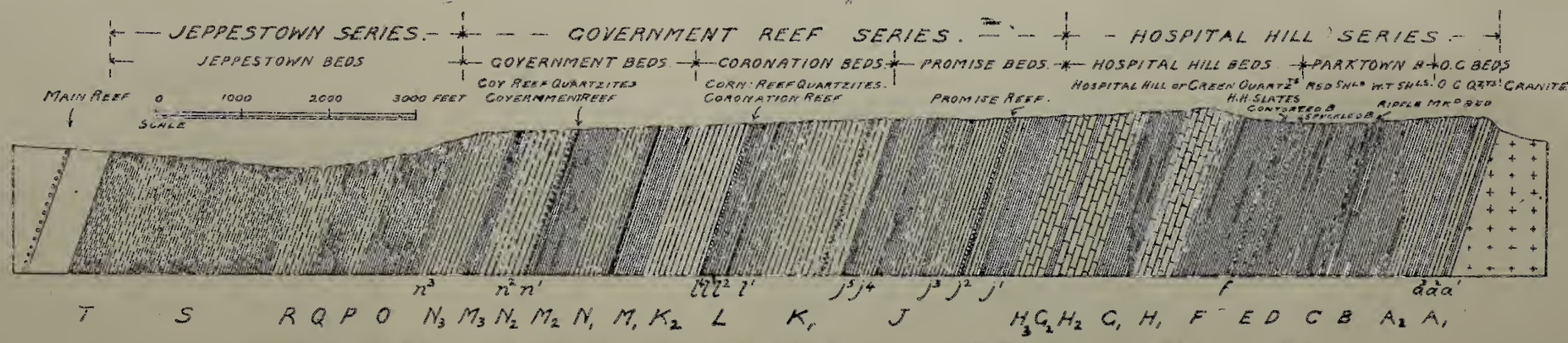


Sir George Albu and a King's Medal Hero at the New Goch

Geology of the Rand



Geological Map of the Lower Witwatersrand Formation on the Central Rand (Geological Survey)



Composite Section of Lower Witwatersrand Series on the Central Rand (Geological Survey). (See Dr. Mellor's description elsewhere in this issue)

whistle. "He is Sharker and Co.'s head man, who floated the beastly concern." That is possibly why the Rand refugees were so carefully fleeced during the war period.

The Chairmen.

From the inception of the Stock Exchange there have been fifteen chairmen, viz., Messrs. B. M. Woollan, James Hay, M. Dold, S. B. Joel, H. Solomon, J. W. Philip, A. Mackie Niven, E. E. Berlandina, A. Sprinz, S. Thomson, J. Roy, W. I. Haley, E. Friedlander, R. A. Bettington, and D. C. Greig, now holding office.

Retrospection and Tragedy.

In writing this story it has been necessary to deal in a somewhat sketchy manner on matters which at the time presented considerable local interest, but which the lapse of years has caused to fade into forgetfulness. Many a time it has been the lot of members to hear the ominous words, "Poor so-and-so has shot himself." The strain of continued anxiety and the shock of overwhelming losses has often proved too much for overtaxed nature, and so many a tragedy has chilled a usually jovial atmosphere.

Varied Character.

It would, however, ill become me to close these notes and fail to place on record, without necessarily giving details, of the wonderful experience in human nature which a membership of twenty-four years must needs bring. Greed, meanness, selfishness, trickery—all these can be found by those who seek for them, but far above these very human weaknesses stand out brightly and distinctly kindness of heart, generosity to a degree almost beyond imagination, sympathy, forgiveness of wrongs, patience, and courageous endurance worthy of the highest ideals of any race.

Father Kelly's Dictum.

Well, indeed, did Father Kelly say: "When I want money for the Home, sir, I don't go to the churches or the good people, but I just come down between the chains and says to these haythens and Jews and infidels, 'Gentlemen, the poor boys is hard up.' And I get all I want. And let me tell you, sir, they're better Christians than any of them." And, in sooth, they are. Little enough have they to give away now, poor fellows, but when they have, it's no case of asking for details; but, for the cause of charity, an old friend in trouble, his wife or children, a poor Dutchman losing his life to help another; it's hand in pocket, pen to cheque, or, as on a well-remembered occasion, "Who'll lend a poor b——y Jew a sovereign?" In conclusion, I can but wish them well and express my firm belief that when the Recording Angel opens his books there is many a pious priest or saintly bishop would fain exchange entries with some of the maligned stockbrokers who have passed their days in this, so-called, sink of depravity conceived in sin and born in iniquity.

Lost Minute Book.

Since writing the "Story of the Stock Exchange," wherein I mentioned that none of the early records could be found, my friend Mr. Hilner, after prosecuting a search of several weeks' duration, succeeded at last in recovering the lost original minute book, from which I have been able to obtain the following additional data:

First Meeting.

The first meeting of directors of the Exchange and Chambers Company was held on August 18th, 1887, at which Messrs. O'Meara, Van Ryn, Bettleheim, F. Gray, and Lang were present. Resolved that the secretary collect the application money of five shillings per share. Mr. Bettleheim was appointed to see Mr. Reid, the architect, in regard to plans. Mr. B. M. Woollan was appointed secretary.

Share Issue.

On October 15th it was resolved that shares be now issued.

Rents.

On October 22nd applications for offices were received, the rentals varying from £6 13s. 4d. to £12 10s. per month.

Chairman.

On November 3rd, Mr. Bettleheim having retired from the board, Mr. B. M. Woollan was appointed as a director and permanent chairman.

Subscriptions.

The entrance fees for members joining prior to March 31st, 1888, was fixed at £5 5s., and the subscriptions 10s. 6d. per month. Members joining subsequent to that date were to pay double.

Secretary.

Mr. F. Rorke was appointed secretary on December 3rd.

Official Opening.

The official opening of the Stock Exchange took place on January 16th, 1888, on which occasion Mr. J. B. Robinson was requested to make a speech, which is not recorded. A calico ball was held in the evening, on which a deficiency of £50 had to be made good out of the funds. The papers subscribed for by the Exchange were the "Daily Independent," "Advertiser," "Financial News," "Mining Journal," "Cape Argus," "Gold Fields Times," and "Transvaal Advertiser." The "Mining Journal" is the only local issue to survive to the present day.

Another Secretary.

On April 11th, 1888, Mr. F. Rorke resigned as secretary and Sir Drummond Dunbar, Bart., was appointed in his stead.

RAND MINING IN PICTURE



Open-fronted Type of Mortar Box, Consolidated Langlaagte

Rand Mining in Picture

GOERZ GROUP



Princess Estate



Princess Estate, showing Recovery Works



Princess Estate; another view

Use of Hall.

A fairly good business appears to have been done by letting the hall for evening entertainments, £5 5s. being the usual fee. One application was received from the Lutheran minister to hold divine service. This was granted, but the minutes are silent as to what fee, if any, was charged.

Changing Secretaries.

The post of secretary does not appear to have been a sinecure, as on December 11th, 1888, Sir Drummond Dunbar resigned, and Mr. G. E. Smith took his place, being allowed £25 for travelling expenses from Cape Town.

Amalgamation.

On February 5th, 1889, an amalgamation took place with the adjoining Tollemache Buildings Company, with a combined capital of £37,500.

Enter Barney.

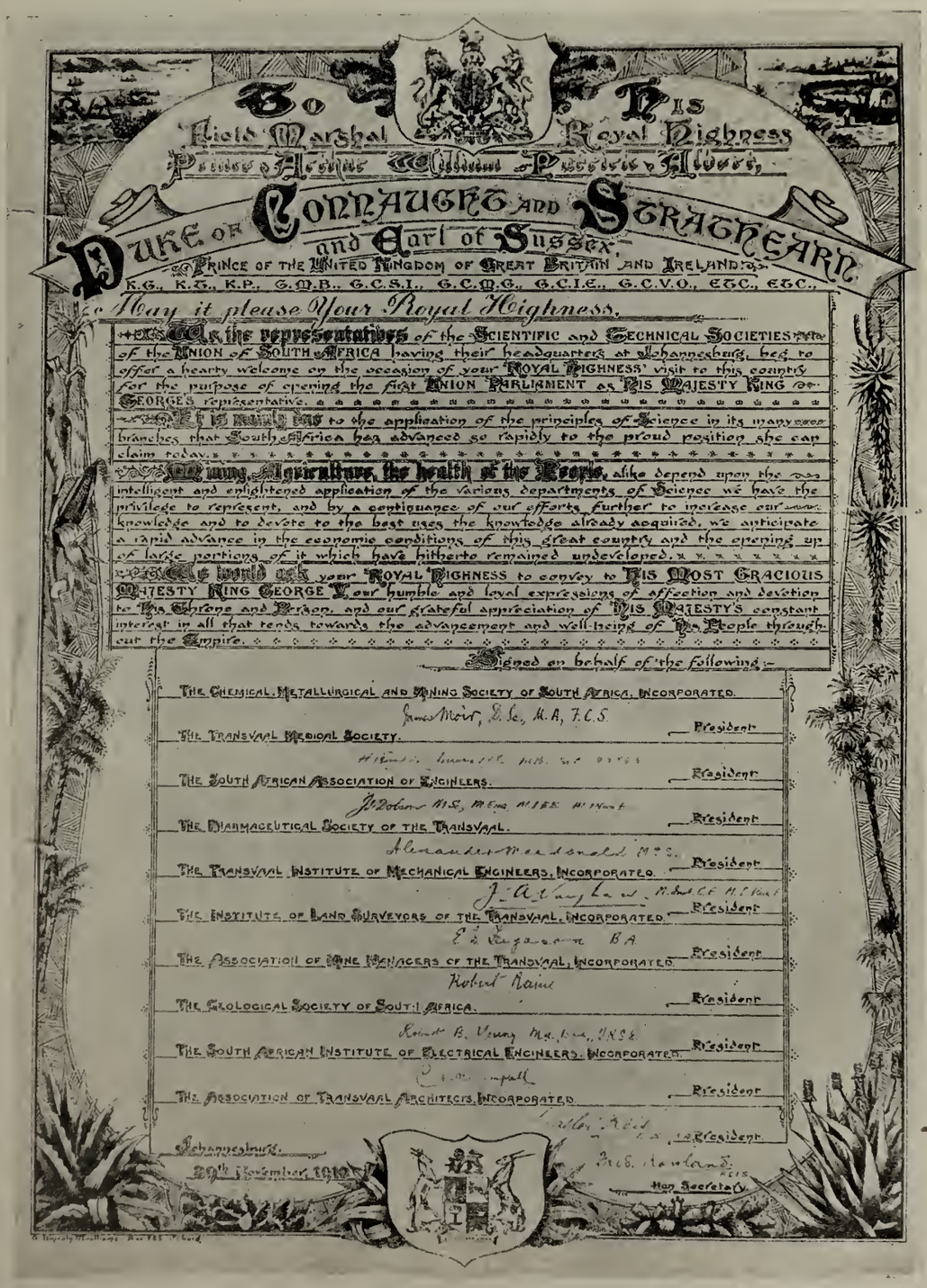
On March 5th, 1889, a letter was received from Mr. B. I. Barnato propounding a scheme for amalgamation with the Johannesburg Estate Company, Ltd., which was agreed to by the directors providing the new company put in as much ground to the block as that occupied by the Estate Company.

Old Company Absorbed.

A general meeting held on March 14th confirmed the agreement.

Dividends.

The Estate Company was a profitable venture to its promoters, as from its inception in August, 1887, to January, 1889, no less than 65 per cent was paid in dividends, to which must be added a final winding-up dividend of 15¾ per cent., or a total of over 80 per cent in eighteen months.


To His Royal Highness Field Marshal Prince Arthur William Patrick Albert,
Duke of Connaught and Strathearn and Earl of Sussex,
Prince of the United Kingdom of Great Britain and Ireland, &c.
K.G., K.T., K.P., G.M.B., G.C.S.I., G.C.M.G., G.C.I.E., G.C.V.O., &c., &c.,

May it please Your Royal Highness,

We, the representatives of the Scientific and Technical Societies of the Union of South Africa having their headquarters at Johannesburg, beg to offer a hearty welcome on the occasion of your Royal Highness' visit to this country for the purpose of opening the first Union Parliament as His Majesty King George's representative.

It is mainly due to the application of the principles of Science in its many branches that South Africa has advanced so rapidly to the proud position she can claim today.

Mining, Agriculture, the health of the People, alike depend upon the intelligent and enlightened application of the various departments of Science we have the privilege to represent, and by a continuance of our efforts further to increase our knowledge and to devote to the best uses the knowledge already acquired, we anticipate a rapid advance in the economic conditions of this great country and the opening up of large portions of it which have hitherto remained undeveloped.

We would ask your Royal Highness to convey to His Most Gracious Majesty King George Your humble and loyal expressions of affection and devotion to His Throne and Person, and our grateful appreciation of His Majesty's constant interest in all that tends towards the advancement and well-being of his People throughout the Empire.

Signed on behalf of the following:—

The Chemical, Metallurgical and Mining Society of South Africa, Incorporated. — James Moir, D.Sc., M.A., F.C.S. — President

The Transvaal Medical Society. — President

The South African Association of Engineers. — President

The Pharmaceutical Society of the Transvaal. — President

The Transvaal Institute of Mechanical Engineers, Incorporated. — President

The Institute of Land Surveyors of the Transvaal, Incorporated. — President

The Association of Mine Managers of the Transvaal, Incorporated. — President

The Geological Society of South Africa. — President

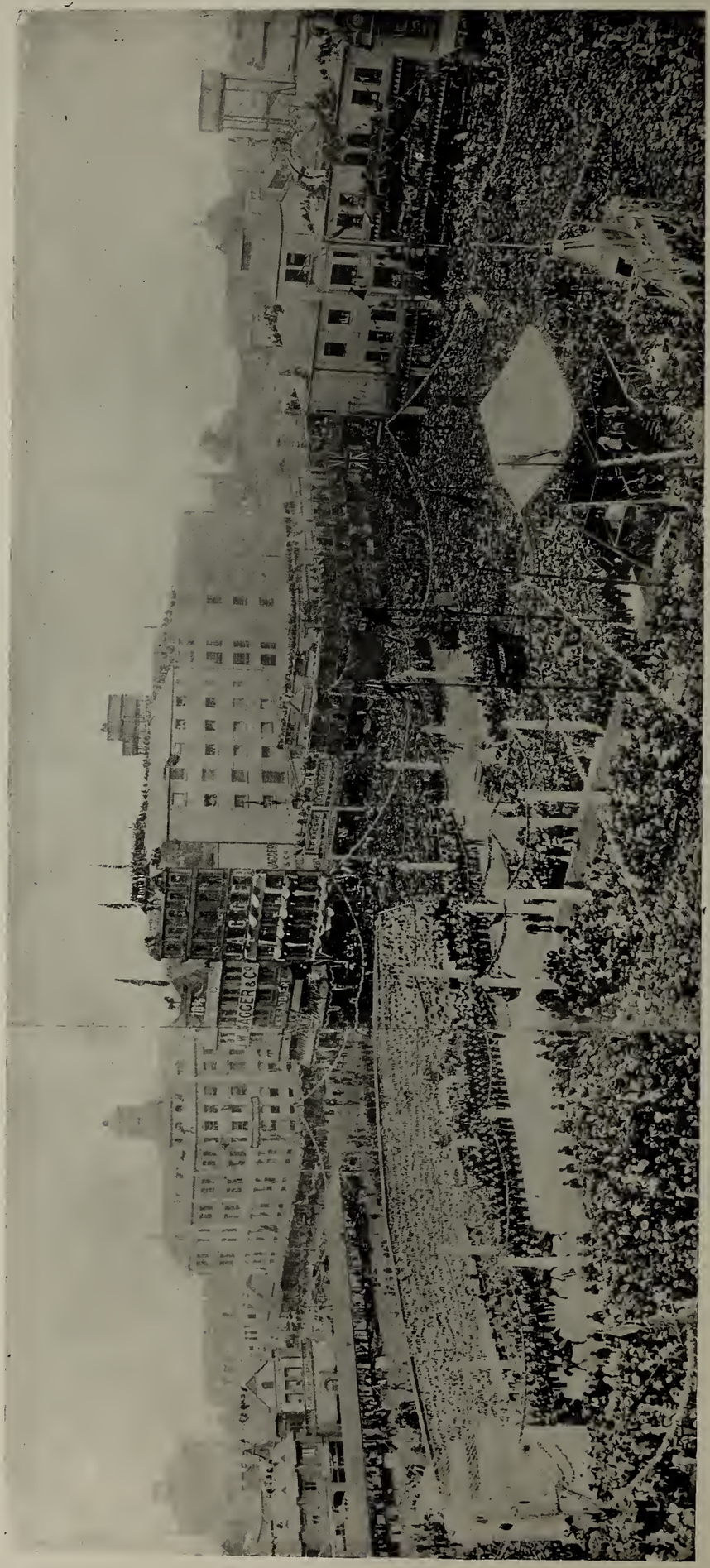
The South African Institute of Electrical Engineers, Incorporated. — President

The Association of Transvaal Architects, Incorporated. — President

Johannesburg, 29th November, 1910. — Hon. Secretary

Address Presented to H.R.H. the Duke of Connaught by Rand Technical and Professional Societies, November, 1910.

An Historic Event in the History of the Rand



H.R.H. THE DUKE OF CONNAUGHT LAYING THE FOUNDATION STONE OF JOHANNESBURG NEW TOWN HALL, NOVEMBER, 1910

The Rand Sixteen Years Ago and To-day

Recollections of the Reef

A Characteristic Article by the Late JOHN STUART

WHEN, in accordance with his pleasant annual custom, the editor of the "South African Mining Journal" gathered many of his predecessors about him, put a pistol at their heads, and demanded a contribution for his anniversary number, I was a little inclined to refuse; because the subject he suggested was a contrast or comparison between the Rand as it is to-day and the Rand when I entered the rather agreeable turmoil of South African journalism some sixteen years ago. It seemed that so many men were so much better qualified to have reminiscences than one who only reached Johannesburg for the first time in 1895. And yet the task of contrast has a singular fascination, and ought to be taken up; and, especially as the men who might write won't, or don't, it is rather a duty for those who remember any matters of historical value to set them on paper.

The Deep Levels.

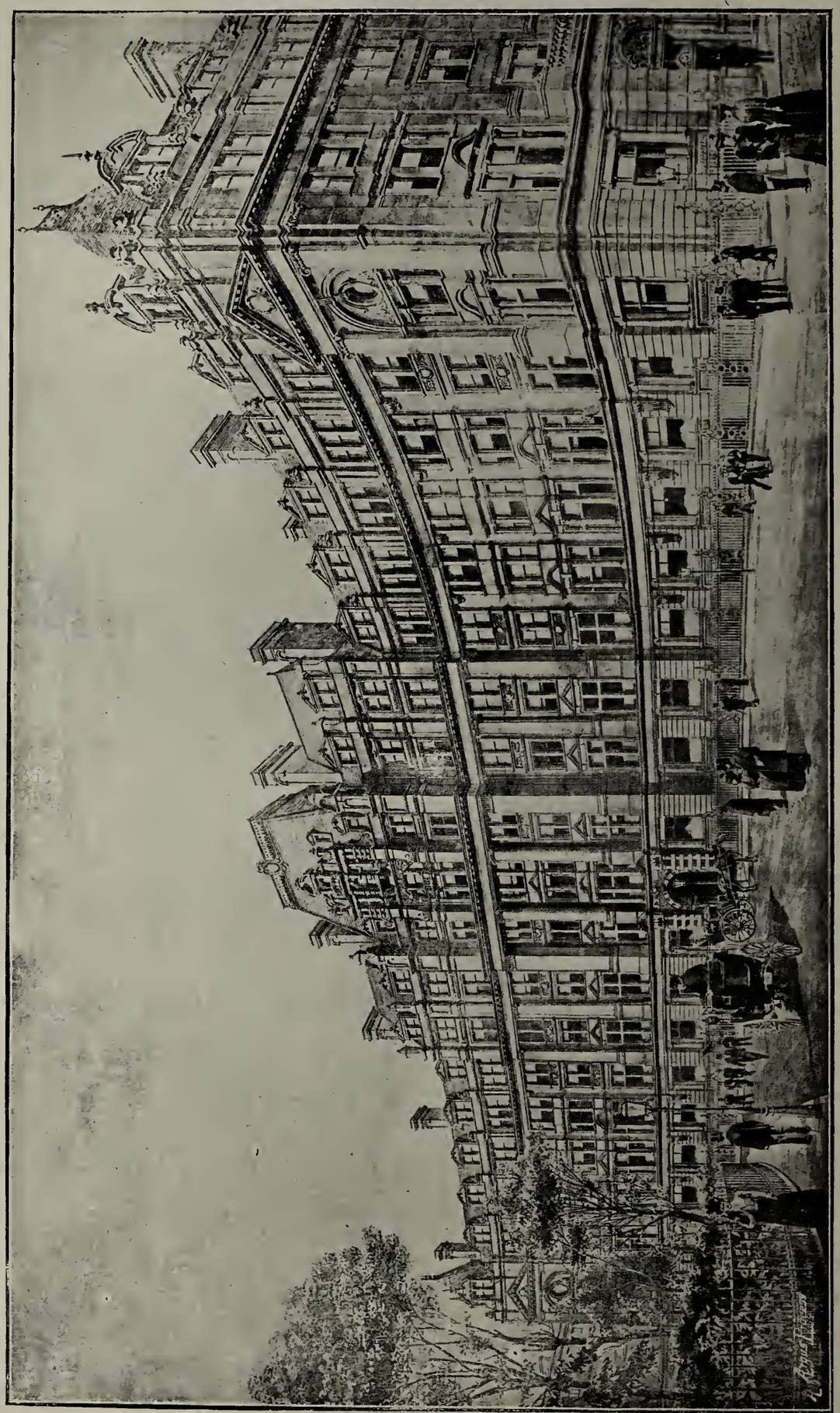
In 1895 all the talk was of deep levels. The first mine I ever saw was the Rose Deep, which was then shaft-sinking. The manager of the period was Richards, who afterwards went to West Africa—I think with Stanley Clay; not our old friend Cap'n Richards of the Ferreira Deep, but a man who had an equal reputation for shaft-sinking and for his fascinating drawl. The theory of deep levels was still on its trial. True, what might be called semi-deeps, like the Village and the Bonanza, were doing well; but not long before that date the "Cape Times" had attacked the Rand Mines, Ltd., as a shameless and over-capitalised wild-cat. J. B. Robinson was openly sceptical about the deeps; and it was early in 1896 that the poor result of the first crushing at the Geldenhuis Deep did nearly as much as the Raid to knock the bottom out of the market. It was in 1897, or perhaps even later, that the market nearly broke its neck over a rumour that the Crown Deep had petered out. The readiness with which the report was accepted showed how slow people were to believe in deep levels otherwise than as a problematical speculation. They never expected the widening of the stopes of the Rose Deep, which astonished those who were only far advanced enough in faith to hold that a deep level would be a replica of the outcrop and no more. Nor did they expect such a mine to pay dividends on six-pennyweight rock. The days of the "solid ounce" theory were over; but a forty shillings return was expected, and the manager whose working costs panned out at less than about thirty-two shillings a ton would have been politely informed how many sorts of a liar he was.

Again, the area of the Reef was supposed to be rather circumscribed. The backers of Randfontein were looked at askance, because the second reef had not been discovered, and the first was insufficiently explored. I remember when Sir George Farrar had to face a crowd of angry shareholders, headed by Messrs. Epler and Leonard Graham, because he wanted fresh capital for the East Rand Proprietary. One does not often see such a display of courage, for both the "Economist" and the "Financial News" were denouncing the East Rand's management, though the mines had shown remarkably high outcrop values. It was a crowded, angry meeting, held in the board room at Bettelheim Buildings, then the fashionable abode for such gatherings; and—fight as pluckily as he might, which he did literally with his back to the wall—Sir George did not get his way. East Rands—who would believe it now?—went down to twenty-seven shillings sellers,



The Late JOHN STUART
(formerly Editor of the "South African Mining Journal")

SALISBURY HOUSE, LONDON



Where the London Offices of the "South African Mining Journal" are situated

and a well-know financier offered me the whole of his five thousand if I would undertake to live on nothing but the dividends. That financier is now making a very comfortable thing out of the dividends, which, had I been wiser, I might have collected. But instances like these are typical of the history of the Rand. The faith of men like Farrar, the late Hermann Eckstein, and of "J.B." has been enough to move mountains.

Changes in Practice.

In 1895-6 mining was cleaner and less hurried than it is now; timbering and pillaring were more efficiently carried out. The old miners were more experienced than the present race, and, having the easier rock of the top levels to work on, got handsome cheques, which, like their managers, they lavished freely on the market. Miners' phthisis was unknown, or, perhaps unrecognised. The best place to find a manager was generally "between the chains," where an agitated crowd assembled every morning. Cyanide practice was still in its infancy. All the vats were of wood. I think it was the Glen Deep that first started steel vats. Tailings wheels and suction pumps were unknown. Silmes were practically untreated; and though experiments towards their treatment were being made, they were regarded as fads of the chemists, and likely to turn out unprofitably. Such sorting as was done, was done on floors. I think it was in '97 that I described the new circular sorting tables at the Jumpers Deep and Glen Deep in the "Mining Journal"; and they are pretty well back-numbered by this day, although Sir Percy Fitzpatrick then called them the smartest things in their own line. In fact, Mr. J. Harry Johns, the manager of the Ferreira, had the utmost difficulty in convincing his fellow managers of the value of sorting. It was a battle in which, I am glad to say, the "Mining Journal" took the right side; as we did in the matter of large claim areas, large batteries, and heavy stamps. But sorting was then called "picking the eyes out of the mines." Of course, there were no tube mills at that time; and certainly no battery was dropping so much as a hundred stamps. The first to do so was Knights. Of these stamps not one weighed more than seven hundred and fifty pounds. One reads quite calmly now of a stamp duty of ten tons or more daily. At that period the stamp duty of a mill rarely, if ever, averaged four tons. The opening of a battery was a memorable event, at which champagne and speeches were rather liberally distributed. Power stations were unknown. I think it was not till 1897 that President Kruger opened that at Brakpan. Belt-conveyors were in the future, mechanical haulage was in its infancy, most of the transport was carried on by Kaffir labour. The Kaffirs were allowed one drink a day, and the illicit liquor trade had begun to show its nefarious head. It was calculated that through this trade about thirty per cent. of the efficiency of Kaffir labour was lost; but it was after the beginning of 1897, when the Prohibition Act came into force, and till before the outbreak of war, that the syndicates made their enormous profits.

Social Life.

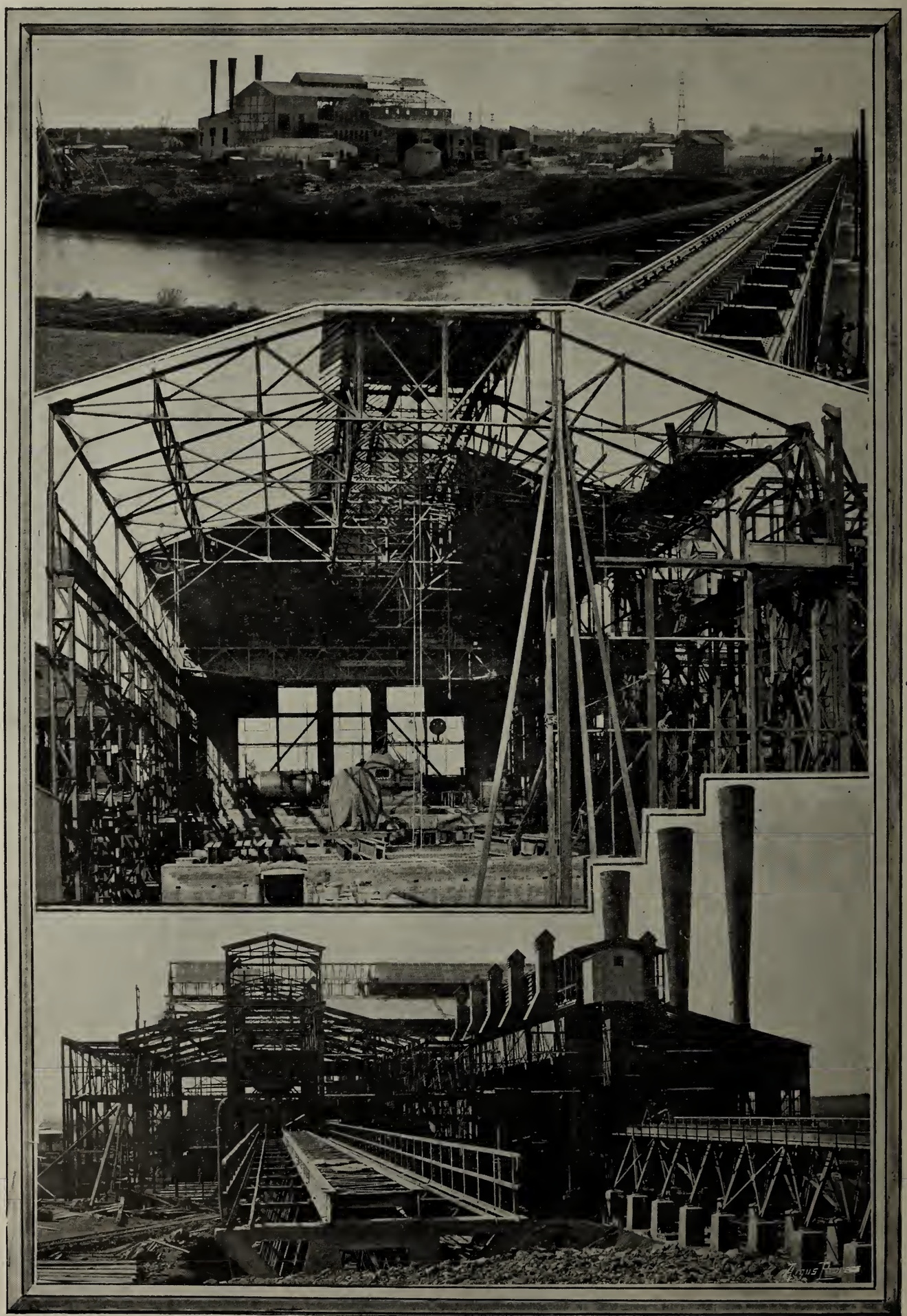
Social life was more compact and active. It is astonishing to calculate the difference that trams, motor-cars, and suburbs have made to Johannesburg. Nowadays we are a congeries of suburban coteries; then we were a civic community, thinking together, sometimes alike and sometimes differently. I well remember the outcry caused by the now forgotten theory of my friend Schmitz-Dumont. It did not matter what you thought of it, but it is quite certain that you talked of very little else. Probably there was no place in the world where public opinion so rapidly concentrated itself. Everyone knew everyone else; and this added to the amenities of life, at the same time increasing the solidarity of opinion. In those days political feeling ran very high, but it did not seem to interfere with private intercourse as it does to-day. There was more hospitality—though people did talk stocks and shares, and occasionally made deals, across the dinner table—but there was less domestic life. The problem then was, "How are we to get freedom?" The present problem, a problem more pressing than people think, is, "What are we to do with these interesting products of domesticity?" It is scarcely to be expected that the sons and daughters of adventurous and gambling pioneers will take quite kindly to the mediocre blessings of a settled civilisation.

RAND SCIENTIFIC SOCIETIES



Chemical, Metallurgical and Mining Societies of South Africa at the City Deep

The Rand's Power Supply



Views of Power Station, Vereeniging, Victoria Falls and Transvaal Power Company

An Early Interview with Sir Lionel Phillips

From the "South African Mining Journal" of Twenty Years Ago—Views on the Future

THE following interview with Sir Lionel Phillips, then Mr. Lionel Phillips, is reproduced from the "S.A. Mining Journal" of April 30, 1892:

REPRESENTATIVES OF SOUTH AFRICAN MINING AND FINANCE INTERVIEWED.

MR. LIONEL PHILLIPS.

President of the Witwatersrand Chamber of Mines.

We have, on previous occasions, given to our readers the views of Messrs. Carl Hanau and G. H. Goch, the Vice-Presidents of the Witwatersrand Chamber of Mines, and have now obtained a similar statement—which will be found similarly interesting—from Mr. Lionel Phillips, the President of that important institution.

Mr. Phillips was born in London in the year 1855, being now 38 years of age. He was educated in the same city, and is a member of the Institute of Mechanical Engineers. He came out to South Africa in 1875 (in the early days of the Diamond Fields) at the time of the rebellion, under an engagement to Messrs. J. B. Robinson and Co.

Career in Kimberley.

Mr. Phillips had charge of the mining business of this firm for six years. In 1880 he left the firm and became managing director of the Griqualand West D. M. Co., in Dutoitspan. In 1881 he went to Europe for a trip, returning in the next year.

On his return Mr. Phillips undertook a contract in the mine of the French and D'Esterre Company, and subsequently made a contract to deliver the diamonds on the table cheaper than it had ever been done before, viz., for four shillings per load, at that time considered a wonderfully low price. This contract ran into £60,000, and on its completion he became manager of the company.

The Consolidation of the Diamond Industry.

From that time forward Mr. Phillips took an active part in the general consolidation of interests, more particularly with regard to the Bultfontein mine. The French and D'Esterre Company forming a nucleus, Mr. Phillips gradually arranged the amalgamation of nearly every company in the mine except the Bultfontein mine, the result being the Consolidated Company, comprising, besides the French D'Esterre the Adamant, Central Bultfontein, Le Diamant, Brodie, Wells, Barker, and other properties.

"The view that I always took of the diamond industry," said Mr. Phillips, in talking over this matter, "was this: For years, while there were all these individual ownerships in the diamond mines, the prices of diamonds were always too low to benefit proprietors or shareholders. The industry was virtually carried on for the benefit of the employees and officials. This was so unsatisfactory that I felt, with Messrs. Cecil Rhodes, Alfred Beit, and others, that some kind of combination was absolutely necessary. I am quite convinced that if consolidation had not taken place, not only would Kimberley, as a town, have been ruined, but the industry also would have gone to the wall. We were actually producing more diamonds than the world could or would buy, and prices naturally became so low that, as far as the poorer mines were concerned, mining was either carried on at a loss or without profit. But for consolidation, the output would have become enormous. Dutoitspan mine alone was producing an immense quantity of diamonds, but the production returned no profit to its proprietors, and the slightest further fall in the price would infallibly have resulted in a loss in working. In fact, many mines did actually work at a loss.

"The Bultfontein mine was a little better than Dutoitspan and the moiety of profit was greater, but even then a very small amount of profit was made, and any fall in prices of the stones would have swept this away.

"In addition to this, the depths of the open workings in Bultfontein and Dutoitspan, thereby causing the reef to become dangerous, would, without any fall in the price of diamonds, have ultimately given the death-blow to those mines."

"What do you think of the Wesselton mine?" we asked Mr. Phillips.

"Well, it was discovered since I left Kimberley, but my information leads me to believe that the yellow ground, at all events, is payable, and perhaps the blue."

"And presumably you consider that the future of the diamond mining industry is now assured?"

"Certainly. I think that it will be a brilliant one, but that it can only be assured by keeping the production under such control as is at present exercised."

Mr. Phillips has hitherto eschewed politics, but has always taken a keen interest in such mining institutions as the Kimberley and Bultfontein Mining Boards, and the Board for the Protection of Mining Interests, of all of which he was a member.

Visit to the De Kaap District.

In 1884 Mr. Phillips went to this district, for the purpose of making a report upon it for Mr. Alfred Beit, with whom he had become acquainted in connection with the French D'Esterre Company. He spent a month or two there, and did not report very favourably upon the district generally, although he could not complain of his visit from a profitable standpoint. We asked Mr. Phillips for his opinion as to their future, and were informed that he considered it rather a difficult country to prospect in, and that the occurrence of gold in the veins was rather capricious. "With much cheaper working, however," he said, "some of the mines may be made to pay. I except the Sheba, which I thought at the time of my visit, and which my latest information still leads me to believe, is a fine property."

Trip to the Zoutpansberg.

After the amalgamation, Mr. Phillips disassociated himself with diamond mining, and in 1888 went to the Zoutpansberg district, and through the Low Country. He did not like the ground in the higher country, and thought the low country properties were more promising. On these latter surface indications have since been borne out in some cases by development. Mr. Phillips does not consider that the Northern Transvaal goldfields will show payable reefs right along the formation, but he considers that patches of reef will be found which will give good payable results.

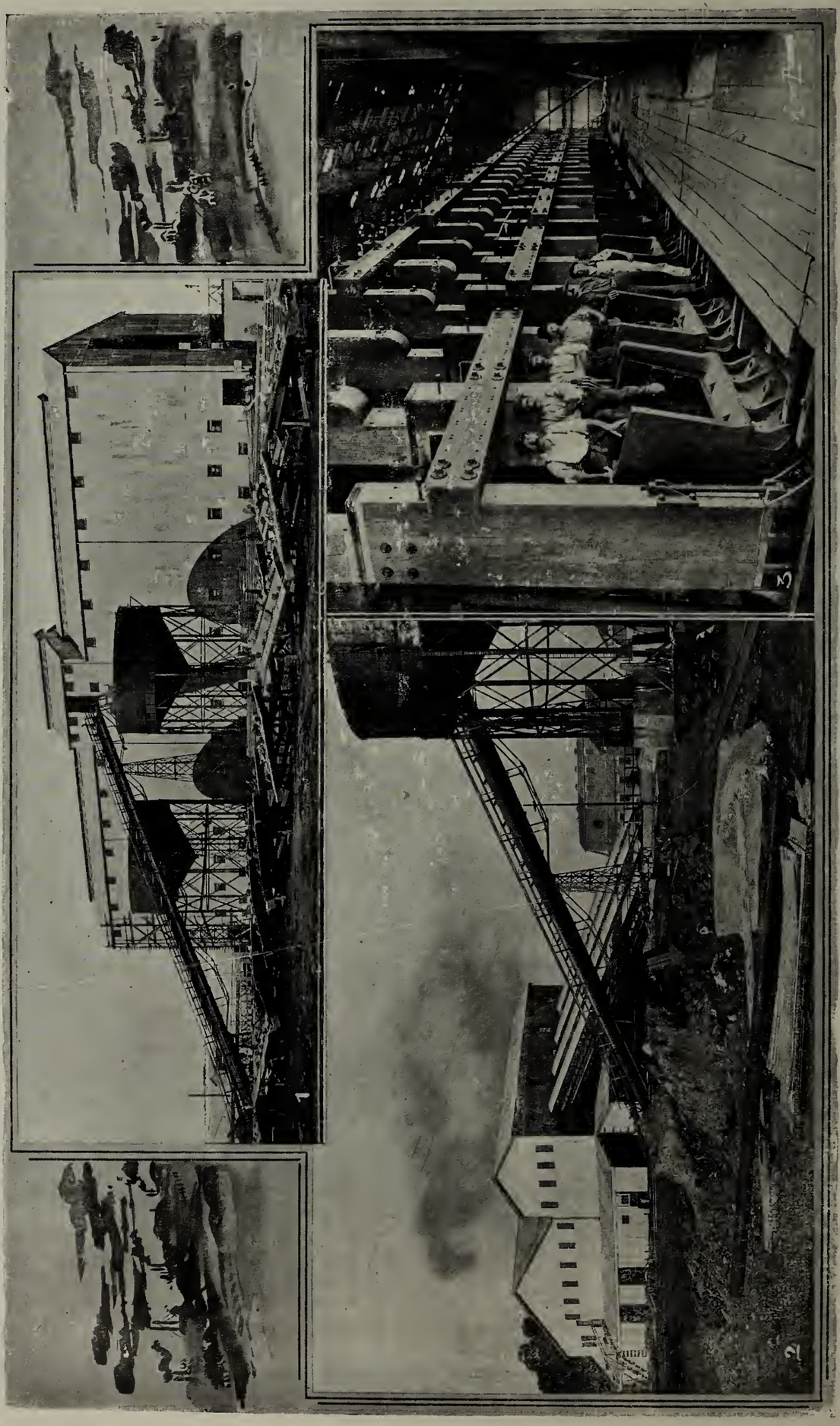
Mr. Phillips came to the Rand in September, 1889. He is a partner in the firm of H. Eckstein, as most South Africans know, the mining department of this immense business being under his particular care.



Alluvial Gold Working in the Transvaal. Tail Race of Metlepitsi, Alluvial Syndicate

Rand Mining in Picture

JOHANNESBURG CONSOLIDATED INVESTMENT GROUP



Views of the New Mill and Surface Equipment, Consolidated Langlaagte

First Impressions as to the Rand.

"Well," we supposed, "you were at once a firm believer in the goldfields?"

"No, I cannot say that I was," said Mr. Phillips. "You see—when I arrived here the more advanced mines were just getting into pyritic rock, and in almost every instance the reefs appeared to be split up at about that depth. This was a thing that militated against the extraordinary results obtained from the free-milling ore, and I felt a certain amount of disquiet until further sinking ultimately proved the reefs to be as solid in depth as they were at the surface. If I may do a little theorising, I think it quite likely that the fact of the reef becoming compact again with the appearances of pyrites has probably checked the oxydising or decomposing process, while the splits in the reef enabled the decomposition to extend to that point."

Fiduciary Positions.

Practically speaking, Mr. Phillips or his firm are more or less connected with nearly all the most valuable properties on the Rand. He himself is a director, amongst other companies, of the Robinson, Crown Reef, Ferreira, Worcester, New Heriot, Transvaal Silver Mines, and Randfontein Estates. We wished to question Mr. Phillips as to the present and future of some of these properties, forming, as "Truth" says, "the pick of the Kaffir market," but he reminded us that if he were to go into such a subject as this it would make our article interminable. We therefore put the time-worn question: "What do you think of

"The Future of the Rand Gold Fields?"

Mr. Phillips said: "I think it is now admitted on all sides that these are probably the most wonderful goldfields that the world has ever heard of. Judging by the enormous lateral continuity of the reef, there can be no question, in my opinion, as to its great depth. And as the introduction of the gold into the banket is probably due to plutonic agencies, the deepest workings in any given mine should show at least as good results as were obtained at the surface. Speaking from my own knowledge, the lowest levels in the mines with which I am familiar show no alteration in the general character of the reefs and the formation, with the exception that the dip shows a tendency to flatten."

"As to the basin theory," said Mr. Phillips in reply to a further query, "one's theoretical ideas on the subject are founded upon the fact that all the Main Reef series, and the formation to the south of it up to the Black Reef, are found dipping to the south, while at Heidelberg the formation dips to the north. At the western end of the Rand, a distinct turn of the general formation to the south is traceable. It seems probable, nay, almost certain, therefore, that the beds were deposited in a basin formation. The great age of the banket reefs may be judged from the fact that in some instances, as the Nigel, the coal beds are formed superimposed upon their edges."

Deep Levels.

"You are, of course, fairly confident as to the value of deep levels?" we next queried, "and as to the flattening of the reefs at lower levels?"

"I am: I hold considerable interests in deep level properties, the future of which I regard as assured. The tendency in all the mines is to gradually flatten out. Where the formation near the surface is found more nearly vertical, the flattening is more rapid as depth is reached, and *vice versa*. I must confess that I hardly think that the reef will become absolutely flat within the limits of economic mining."

"Then your opinion as to the relative values of outcrop and deep level claims is—?"

"That the deep level claims are worth as much as the others, less the extra cost of shaft sinking, and the extra cost of haulage from greater depths, which latter item is, however, a very trifling one. In other words, the value of a deep level is dependent upon the dip and the distance from the outcrop."

Amalgamation on the Rand.

In reply to a question on this subject, Mr. Phillips said: "What I think about amalgamation is this: that within reasonable limits, and assuming that a fair financial basis of amalgamation can be arranged, it is a good thing for the companies. Such a step in the case of the goldfields would be purely, of course, with a view of increasing the output and decreasing the working charges. For instance, it requires, to work a gold mine successfully, a general manager, with heads of the following departments: The mine, mill, machinery, and shops, with a good surveyor and assayer. The mine should be sufficiently large to keep all these officials fully employed, and as good men are required, who in turn want good salaries. I think that a mine should be sufficiently large for this purpose. Larger mines would allow of greater concentration of machinery, and would mean a certain saving in development. Where amalgamation is not possible, co-operation in working would, at least, effect some substantial saving. For instance, deep level companies could haul through the incline shafts of outcrop companies, if the latter were sufficiently equipped."

The Witwatersrand Chamber of Mines.

Mr. Phillips has been on the Executive Committee of this institution since his arrival at the Rand, and has recently succeeded his partner, Mr. H. Eckstein, as President. It is sufficient for the purposes of this article to say that he has taken the keenest interest in the invaluable work of the Chamber, and that he has been one of its most useful members.

Mr. Phillips informs us that he had no doubt but that the Government would see its way to give an official standing to the Chamber when it was perfectly satisfied that the Chamber's work would be purely of a mining and non-political character. Such, of course, actually was the case, but the thing was to convince the Government. The Chamber was becoming a more important body every year, and would no doubt ultimately resemble the Colonial Mining Boards in constitution and character.

The Dynamite Question.

"And now, Mr. Phillips, what about the burning question of the dynamite concession?"

"My sentiments on this point are pretty well known. I think that the principle of a monopoly for anything so essential to the mining business is a mistake, and as the real ingredients of the dynamite are not manufactured in the country, there is no compensating benefit to the community in the shape of a large industry."

"But would you not be in favour, if a *modus vivendi* fair to the mines could be arranged, of coming to some arrangement with the concessionaire Company? It would appear that the latter are at last wishful to come to terms."

"I hardly think," said Mr. Phillips, "that I can answer that question, in view of my position in the Chamber of Mines. However, speaking as an individual, I do not think that the question should be fought out simply on the ground that it is a monopoly alone, if a settlement could be arrived at which would be in no way inconsistent with the interests of the mines."

The Sunday Milling Question.

"The next most vexed question of the hour, Mr. Phillips, is the Sunday shutting-down movement. Do you think that the closing of the mills would facilitate religious observances?"

Mr. Phillips was emphatic in his reply. He said: "No, I do not think so at all. In a mill that is being properly worked, there is scarcely more than one amalgamator and engine driver (I speak of white men) in a mill on Sundays and feast days. If you close the mills, you would still have to retain at least two men to guard your mill, and the men at the pumping station would also have to be employed, because if you do not run water over the plates, the amalgam would set, which would mean the loss of Monday to put them in condition again. In any case, no larger proportion of the men could get to church. Another point is that you would have to discharge almost a sixth of the mine hands, as there would be so much less work for them."

"It would of course be impossible to stop the mine pumps?"

"If you did so you would also have to stop mining too." Mr. Phillips went on to say that the closing of mills on Sunday could never be seriously attempted, and that it would be just as sensible to pass a law forbidding cooking. The loss to the country would be at least £700,000 per annum at the present time, but would, of course, be progressive with the increasing output. The gold industry was totally different to ordinary manufactures, where the whole staff could stop work. In this case it would merely mean that the mill would practically still be running, and the same number of men be employed, at a ruinous loss to the companies. Still further, as there are three shifts, the men could easily go to church now if they wished to do so."

Railways and General.

Mr. Phillips referred to the great damage which had been done to the reputation of these fields by the over-speculation of 1889, but said that people in Europe were again coming to the conclusion that a highly profitable industry, capable of infinite extension, was being built up. He mentioned his belief that some of the reefs south of the Main series would be found payable. As to railways, Mr. Phillips said: "Apart from the considerable saving in carriage on machinery, cereal supplies, and building materials, I think that the advent of railways will bring in a large increase of population, carrying in its train more skilled labour and further capital. I think that the Charlestown Extension should be brought through the Silver Mines, as it would result in great benefit to the industry."

The Transvaal Government.

Asking for Mr. Phillips' views on this important subject, he answered: "It would be observable that the general attitude of the members of the Executive on the occasion of their recent visit was distinctly favourable towards the development of the industries and resources of the country. Their tone showed that the day is rapidly approaching when it will be fully realised that we simply desire the welfare of the whole country. When that is a little more fully realised there is no doubt but that most of the restrictions upon the manufactures and industries of the State will be removed, as well as the political disabilities of the new population."

This ended our interview, and Mr. Phillips' utterances may be safely left to speak for themselves, and his many important positions give the greatest weight to his delivered opinions upon matters relative to mining finance. His remarks on the dynamite question will not be without significance to parties interested, and his sentiments upon this and the Sunday closing question, it gives us pleasure to note, entirely accord with the views of the "Journal."



A New Rand Borehole Site, Vaal River

Rand Mining in Picture



Crown Mines Mill under construction



Views on the City Deep Gold Mining Company, showing the West Shaft, Tube Mill Plant, Slimes Plant and Trestle Track to Mill

Story of the "Cullinan" Diamond

By Dr. MOLENGRAAFF

BY the courtesy of the directors of the Premier Diamond Mine, the record diamond found on January 26th, 1905, was made accessible to private inspection in one of the rooms of the Standard Bank Buildings. A cursory examination gave the following details:—

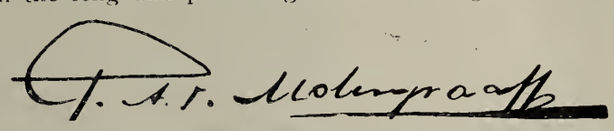
The big diamond is a portion of a much larger stone, the original form of which can only be roughly guessed at. Four pieces of this original stone have been broken off along cleavage planes, which we know to have the position of octahedral planes. Each of these fragments must have been of considerable size. Consequently, the stone itself shows only a portion of its original natural surface (called "nyf" in the diamond-cutters' jargon), the greater portion being formed by these four flat cleavage planes. The remaining part of the surface shows one octahedral face and a curved irregular surface roughly corresponding to six faces of the dodecahedron, while one very irregular face of the hexahedron is indicated by quadrilateral impressions which are characteristic of these faces in minerals, such as the diamond, which possess the octahedral mode of growth.

The stone is a single crystal, no twinning planes or twinning lamellæ being present.

The stone is quite colourless, its perfect transparency being best compared to that of pure ice or of the variety of silica known as hyalite.

There are a few grains (inclusions) and also some flaws or internal cleavage planes—"glessen" as the diamond-cutters call them—in it, but their position is such that they do not detract from the value of the stone as a gem. It is certainly the purest of all the very big stones known.

The question is raised whether there is any likelihood of finding the fragments which have been detached from this stone by cleavage. It is, of course, possible, but nobody can say whether or where they will be found in the mine. Diamonds are formed at very great depths from carbon dissolved in the molten basic igneous rock (blue ground), from which under the conditions of enormous pressure and very high temperature which prevail at these depths, the carbon crystallises out in the form of diamonds. During the period of eruption, the diamonds were carried to the surface with great force, and the excessive friction which must have existed in the magma during ejection through the crater pipe, caused the fragments to be cleaved from the original stone. They may have been blown out during the eruption, or they may still be in the volcanic chimney (diamond-pipe) and may be unearthed some other day in the long and promising life of this big mine.



RAND'S POWER SUPPLY



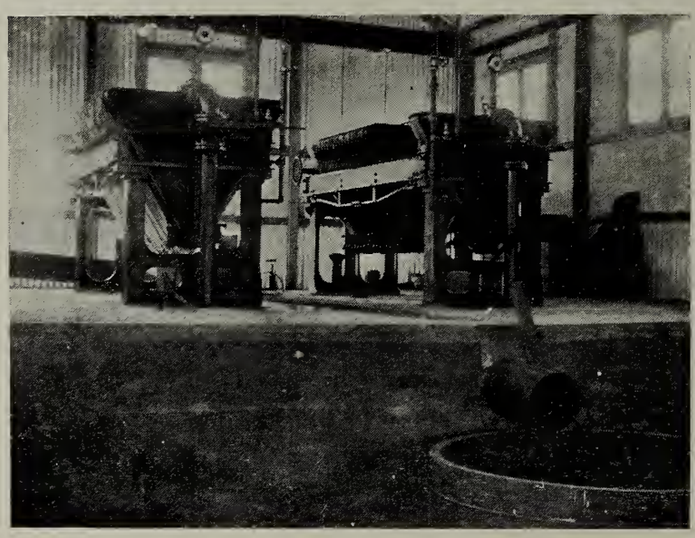
Rosherville Statoin, Victoria Falls and Transvaal Power Company

An Outside Mine.—French Bob's

SHOWING PACHUCA VATS, MERRILL FILTERS AND GENERAL LAY OUT OF PLANT



Views of French Bob's Plant, Barberton



Merrill Filters at French Bob's



French Bob's. A General View

Earliest Discoveries of Diamonds

IN CAPE COLONY AND THE TRANSVAAL

By DAVID DRAPER

TO me, Saturday, November 6th, 1869, is a red letter day in the history of South Africa, for I hapened to be present when Cornelis du Plooy, then owner of the farm Bultfontein, walked into the store of Mr. E. E. Hurley, now of Johannesburg, carrying in his hand a small bottle, filled with stones, which he had collected on his homestead. Amongst these worthless pebbles there was one small diamond. When Du Plooy was informed, his surprise found expression in the remark that there were so many of those things lying around on his place, he did not consider them worth picking up. Lilienfeld, Hurley, and Hond purchased Bultfontein from Du Plooy, and thus became possessors of the first true diamond mine in South Africa.

Prospecting operations on the adjoining farms, Dutoitspan and Vooruitzicht, resulted in the discovery of the Dutoitspan, Old De Beers, and Kimberley mines. Jagersfontein was found after Dutoitspan and before Old De Beers. Twenty-four years later the Wesselton mine was discovered. Previous to the "dry diggings," diamonds were found in the alluvial gravels of the Vaal and Riet Rivers, and in the year 1873 in the small creek below the Lace mine, on the farm Driekopjes, Kroonstad district, Orange Free State.

Diamond Discoveries in the Transvaal.

The following cutting from the Queenstown "Representative," dated March 3rd, 1871, shows that diamonds were found in the Transvaal at a very early date:—

"Great excitement was caused here a few days ago by young Joubert bringing in a diamond of four and a half carats which he found on the farm of Mrs. Hennessy, about two and a half miles from here (Pretoria). The Government at once took steps, sent out a commission, Broderick, Lys, Skinner (the two former lately from the Diamond Fields), and their report is of such a nature that I have no doubt that in a week there will be quite a crowd at the new diggings."

Piet Marais and H. Struben have taken a lease of part of the farm, and will commence operations at once. Several farmers have found diamonds on the banks of the Elands River. Two diamonds have been found at Zoutpansberg, the Government has sent for them to be tested here—expected next week. In 1870 a diamond had been found at Rustenburg. It was valued at £150. These finds were not considered as of much account. The diamonds were looked upon as emigrants, most likely lost by natives returning from the Diamond Fields.

Later Discoveries in this Colony.

In April, 1897, Mr. W C. Schuller, watchmaker and jeweller, Rissik Street, Johannesburg, brought a small bag containing minerals for me to inspect. He asked my opinion on the specimens, stating that his eldest son had pronounced them to be "dwyka conglomerate." Upon my assuring him that they were "hardbank" from a diamond mine, he was greatly surprised, and became very excited. He told me that the specimens were from a farm held by him near Pretoria, and, that if I was certain that they were from a diamond mine he would institute a search for diamonds, and promised me a handsome reward. Mr. M. E. Frames entered my office during this conversation, and after examining the rocks he confirmed my opinion, which was further endorsed by Mr. H. S. Harger the same day.

Mr. Schuller informed me that he had taken up the property on the advice of a Mr. van Diggelen, who assured him that the red specks in the rock (actually garnets) were cinnabar. Schuller told me that as he knew nothing about diamonds, and had no one to advise him, if I would assist him he would give me an interest in the property. In August, 1897, Mr. Schuller came again to see me, and he brought a small diamond which he stated had been found by Van der Merwe, the owner

RAND MINING IN PICTURE



Robinson Gold Mining Company, West Shaft

Rand's Power Supply



Vereeniging Power Station, Victoria Falls and Transvaal Power Co., Ltd.



Vereeniging Power Station under construction

of the farm, near the spot where the "hardbank" cropped out. I agreed to visit the property the next day (Sunday) together with Mr. Schuller and Mr. F. W. Bawden. We found Mr. Schuller's younger son at the mine, where he had dug a few shallow pits, all in diamond-bearing material. I measured the circumference of the mine and investigated it generally, confirming my previous opinion that it was a true diamond-bearing pipe. Mr. Schuller requested me to instruct him in the method of searching for diamonds, stating that neither himself nor any one connected with the venture knew anything about the business. On my return to Johannesburg I requested Mr. M. E. Frames to go out to the property and teach Mr. Schuller, jun., how to wash and sieve the diamond-bearing rock. This he did, returning on the following Saturday with one small diamond. Mr. Schuller, jun., continued washing operations for some time, finding a quantity of diamonds. Later on Dr. Molengraaff visited the spot and confirmed my opinion that a true diamond-bearing pipe had been discovered in the Transvaal. In company with Mr. Schuller, I interviewed the Second Volksraad, then in session in Pretoria, and showed the diamonds to the Chairman and members. On September 13th, 1897, I read the following paper at a meeting of the Geological Society:—

Diamonds.

Mr. Draper wished to notify to the members of this society that a most interesting discovery of a diamondiferous pipe had been made lately in the vicinity of Pretoria. He had the permission of the owners to make public the fact that diamonds had been found in what appeared to be a small volcanic pipe, containing minerals closely resembling those in older known diamond mines. Garnets, "carbon," olivine, and other minerals associated with the diamond, were there in abundance, and, up to date, eleven diamonds, one weighing sixteen carats, and several smaller ones, had been found in washing the blue. The interesting feature regarding this find of diamonds was that it was the first undoubted diamond mine found in the Transvaal, and as it was situated in the quartzites of the Magaliesberg, it was in a geological horizon much older than the Karroo shales of Kimberley, and also than the cave sandstones wherein the Monastery diamond mine was situated. As there was every likelihood of other diamond mines occurring in the neighbourhood of the new discovery, he had obtained the owners' permission to state the above particulars in order to stimulate research in that part of the country.

The Unprecedented Premier.

The statement in the last paragraph of this paper has been amply verified, and the discovery of true diamond-bearing pipes of exceptional richness in the Transvaal is now an established fact. The late find at the Premier Diamond Mine is unprecedented in the history of diamond mining in the world. In other ways the discovery of true diamond-bearing pipes in the Transvaal has had far-reaching effects. The old theory that diamonds were derived from the carbon extracted by heat from the carbonaceous shales which surrounded the old craters near Kimberley has been exploded, and the contention which every Kimberley man maintained so stoutly, "that there were no mines outside of the Kimberley and Jagersfontein areas," has been completely dispelled. Kimberley men held that no "hardbank" could exist as a surface rock, and that consequently the Schuller could not possibly be a diamond mine, but they found out that they had a good deal to learn about diamond mines. Most probably neither the largest nor the richest diamond mine has been discovered in South Africa, and the fabulous yield of the Premier should be a stimulant for further research. Great things grow from insignificant beginnings. Du Plooy's visit to Hurley's store was the first stage in the development of the greatest diamond industry in the world, and Schuller's interview with myself was the initial step in the diamond industry of the Transvaal.

RAND MINING IN PICTURE



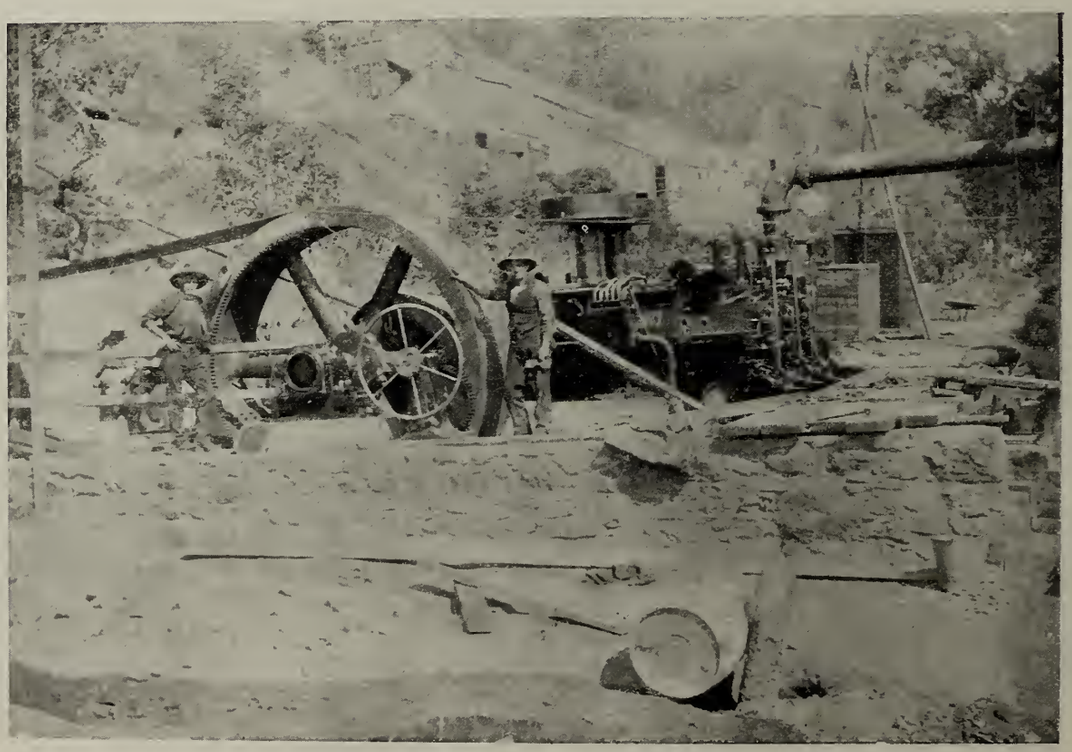
The Benoni Company's New Mill

Transvaal Tin Mining in Picture

GROENFONTEIN TIN MINE EQUIPMENT



Premier Producer Plant



Premier Gas Engine

Working Costs on the Rand

By Professor J. G. LAWN
(Consulting Engineer, Johannesburg Consolidated Investment Company, Limited)

BOTH the present prosperity and the future continuance of the gold mining industry of the Rand are largely dependent upon the cost of winning ore from underground and extracting the gold from the ore on the surface.

There is no reason to think that the supplies of gold-bearing rock in this country will ever be exhausted. Gold has been found in the Main Reef banket beds at the lowest depths to which they have been followed, and it no doubt occurs at still greater depths than those heretofore explored. It may prove, when fuller data than that at present available is obtained and correlated, that there is an average decrease in the gold contents of the banket reefs as greater depths are attained; and there is no doubt but that the engineer will have to face higher temperatures and greater rock pressures in depth. However, the grade of the ore cannot be increased either by science or energy, but must be accepted as it comes from the hand of nature. Temperatures certainly increase in depth on the Rand, as they do in all countries, yet the rate of increase here is quite unusually slow, and their effect can be overcome by ventilation, or by more stringent measures, such as refrigeration, if that were necessary, so that it is not probable that increase of temperature will be the final block to the continuance of mining as greater depths are attained. The increase of rock pressure in depth has, in a few cases, led to dangerous accidents, but as its effects become better understood they will be brought under control and are likely, in some instances at any rate, to prove beneficial in cheapening the breaking of rock in stopes. Thus, the depths to which the reefs can be worked is chiefly a question of working costs.

Further, there are other gold-bearing reefs besides the Main Reef series on the Rand, as, for instance, the Kimberley Reef series, and the reefs in the Klerksdorp and Heidelberg districts. Indeed, there is an almost inexhaustible supply of gold-bearing rock in the Transvaal, which would be available could working costs be reduced sufficiently low to allow of its exploitation at a profit.

The question of the more complete extraction of gold from the ore is, of course, important; but seeing that the best plants now secure from ninety-three per cent. to ninety-five per cent. of the gold actually present, not much more can be hoped for in this direction; and metallurgical improvement is more likely to be profitable in the direction of decreasing capital expenditure on plants and working costs than in improving extraction.

Working costs on the Rand comprise the ordinary, regular expenses involved in working a mine and in running the company owning the mine. Extraordinary expenditure, such as additions to plant, are charged to capital account. Practice is not quite uniform. For instance, shaft sinking, in the initial stages, is always charged to capital account, whereas the deepening of inclined shafts from time to time as development proceeds is, by some companies, charged to working costs, and by others to capital account. The monthly profits declared are the differences between the value of the gold won and the working costs plus any income a company may have from other sources. These profits are not the profits divisible amongst shareholders, for in the first place there is the Government tax of ten per cent. on profits to be deducted, and then there is the amount spent on capital account. Both these items are usually deducted from the aggregate of the monthly profits at the year end. There may also be other charges, such as debenture interest, debenture redemption, or an annuity to Government on account of special mining rights acquired from Government. These also are usually deducted from gross profits at the year end. These items should really be added to working costs month by month; but he working costs would be so distorted, owing to the different ways in which companies are organised, that they would be useless for purposes of comparison. Further, if the true profit made by working a mine had to be shown, it would be necessary to add to the working costs interest on the capital expended for development and equipment, and the necessary amount to provide for the redemption of the capital expended within the life of the mine; for capital is just as necessary an implement in the working of a mine as labour and materials. If this were done, I am afraid that some of our apparently profitable mines would be seen to have really yielded no true profit at all. However, as the more important financial aspect of a mine is its present value, this view is rarely studied.

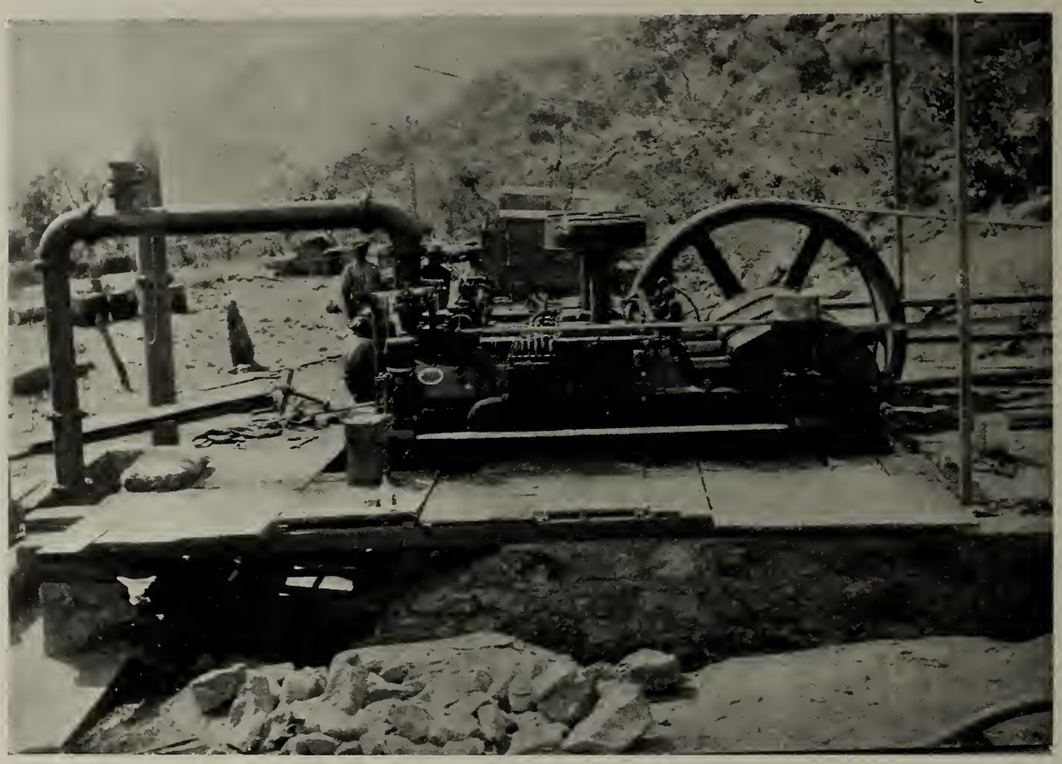
RAND MINING IN PICTURE



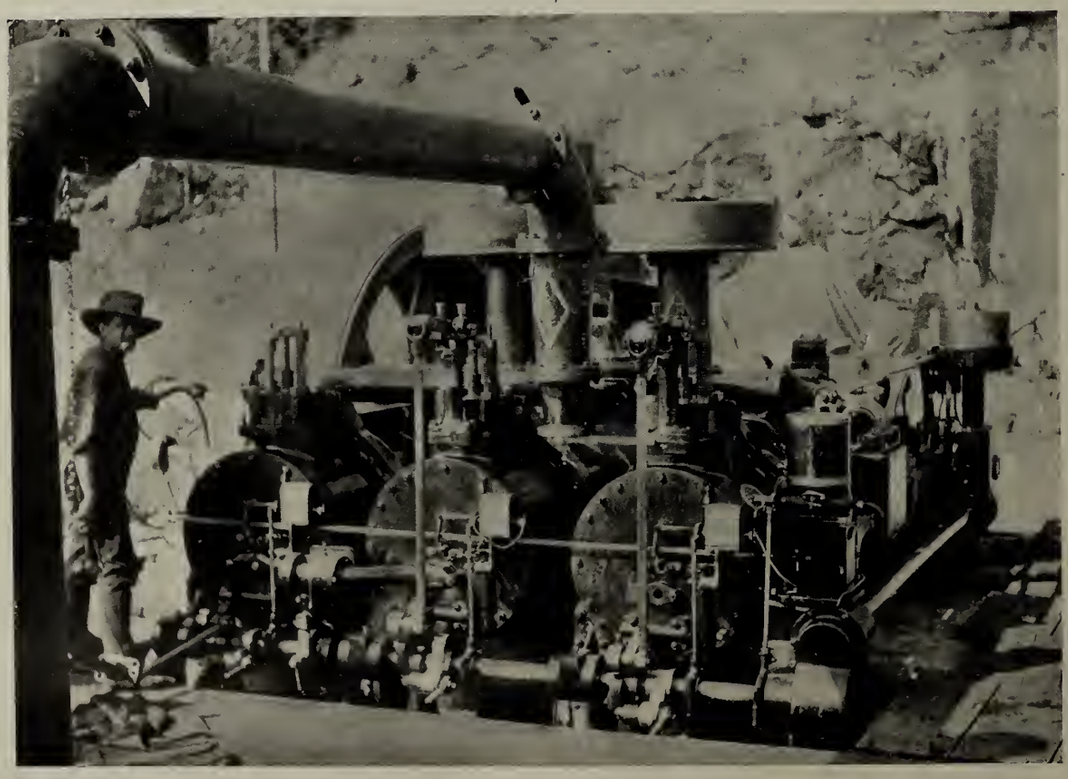
The Crown Reef Mill, Crown Mines

Transvaal Tin Mining in Picture

GROENFONTEIN TIN MINE EQUIPMENT *(Continued)*



Premier Gas Engine. Another View



Yet Another View of the Groenfontein Gas Engine Plant

The present method of declaring working costs has been in vogue from the early days of the Rand, and it has the advantage of giving figures which are more or less comparable, both with those for the same mine at a previous period of its history, and also with those for other mines. The declared profits, in most cases, also give some indication of the dividends which will be paid.

Looking at the cost of working mines over a long period of time, a tendency to increase is universal, owing to the increase in the value of human labour, or, to put it another way, owing to the decrease in the purchasing power of money. Thus it is evident that the cost of working mines in Cornwall in the time of Queen Elizabeth, when tinners received two pence per day, must have been very low. Indeed, working costs in Cornwall have probably never been higher than they are to-day. Illustrations of this general tendency might also be drawn from coal mining in Great Britain. It is true that improvements in plant and methods, to some extent, counterbalance this tendency, and, in particular cases, they may more than counterbalance it; but, generally speaking, the tendency is marked. When, however, a new mining district is discovered, there are often circumstances which make working costs enormously high to start with. Thus the district may be inaccessible and transport costly; it may be very sparsely inhabited, so that a mining population has to be attracted to it; it may be unhealthy; or the ores may be difficult to treat by known methods. However, if the deposits of mineral are sufficiently rich, all difficulties are overcome one after the other, and working costs gradually come down year by year until something approaching a stable figure is arrived at.

This has been the history of working costs on the Rand. At first working costs were very high, but they have constantly tended to decrease, though, during the last year or two, there has been a little reaction, which it is hoped is only temporary. In 1888, working costs at the Robinson mine were 72s. 1d. per ton; in 1894 they were 41s. 4.7d.; in 1898, 25s. 2d.; in 1908, 12s. 7d.; in 1910, 12s. 2d.; and in 1911, 14s. 8d. In 1897, the average working costs of twenty-eight companies were 27s. 4d. per ton; whereas in 1909, the average of the whole Rand was 17s. 3d. For last year the average of the Rand was 18s. 0d. When it is remembered that this is, on the whole, a low-grade mining field, it will be understood what immense tonnages of ore this reduction in working costs has made available for profitable exploitation, which, otherwise, would have had to remain unworked. The old pioneers tell us that no ore under an ounce per ton was thought anything of in the early days. Now we are thankful for five or six pennyweights, and one or two mines make a profit on an average recovery of four pennyweights. The lowest working costs on the Rand have been secured at the Knights Deep mine, where last year 727,830 tons were dealt with at an average cost of 11s. 2d. per ton.

Although there is a general similarity of conditions amongst the mines of the Rand, it should not be overlooked that there are very real differences which affect working costs. Thus, it cannot be expected that mines with very narrow reefs can be worked as cheaply as those with wide reefs. Then again, the angle of dip, the degree to which an area is broken by dykes and faults, and the percentage of payable reef in an area, all have a serious incidence on working costs; so that when the working costs of a few of the most cheaply worked mines are taken, and it is assumed that the working costs of all the mines on the Rand can be brought down to the average of these, a very grave error is being made.

It is scarcely necessary to point out that working costs may be illegitimately reduced by neglecting development and the maintenance of plant; and, most of all, by milling large quantities of low-grade rock. The former procedure only postpones the day of reckoning, whereas the latter, though it does reduce working costs, at the same time reduces profits. The aim of a manager should be maximum profit, which is by no means synonymous with minimum working costs. It is to be feared that the policy of equipping mines with very large mills, which has been adopted in some cases, has proved a great temptation to managers to break and treat unpayable rock. However, a legitimate reduction of working costs—that is, a reduction secured whilst a mine is being worked efficiently from every other point of view—is clearly the first aim of a good manager. It can scarcely be believed that a limit has been reached on the Rand.

Working costs are chiefly made up of labour and stores. The former, in this country, may be sub-divided into cost of white labour and cost of coloured labour. The proportions of the total costs under each head vary

RAND MINING IN PICTURE



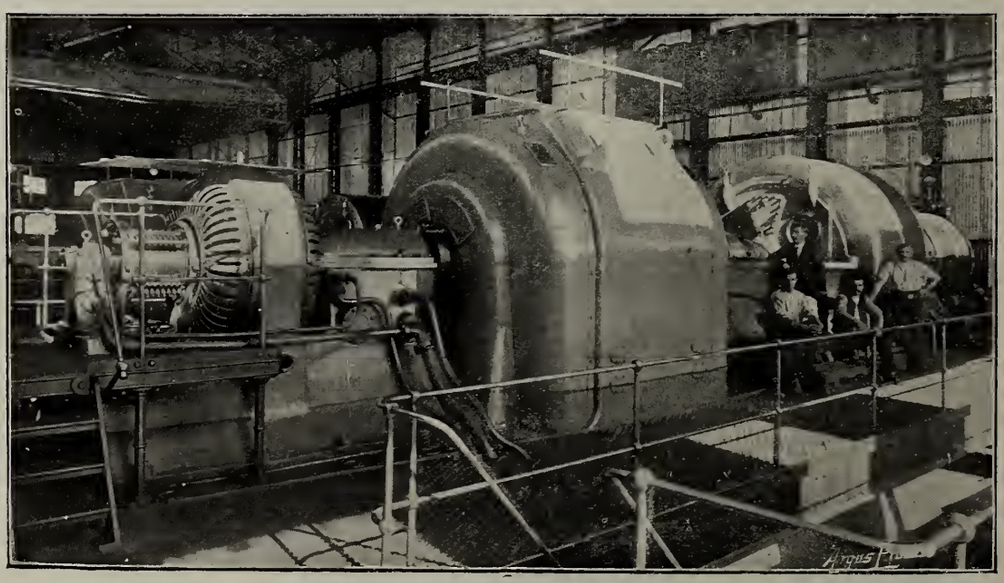
Bleichert Sands Discharge to Waste Dump, Brakpan Mines

Rand Mining in Picture

ROBINSON GROUP



Belt Conveyors to Mill, Randfontein Central



Randfontein Central Turbine Room at Power Station

considerably on different mines, but they may be taken to be approximately as follows: white labour, thirty per cent.; coloured labour, twenty-eight per cent.; and stores (not including native food, which is included in the cost of native labour), thirty-five per cent.

ALLUVIAL GOLD IN THE TRANSVAAL



Metlepitsi Alluvial Syndicate Water Flume



Metlepitsi Alluvial Area

The wages of white miners are high partly because the cost of living is high. There is, however, no doubt but that the high wages of underground workers is, to some extent, accounted for by the danger of miners' phthisis. This disease is known in most metalliferous mining districts, but it is especially virulent on the Rand, where hard quartzitic rock is universal, and where underground work is carried on at high pressure. Not only have many underground workers died from this complaint, but the fear of it reduces the stream of immigration, so that good miners are scarce and obtain high wages. Amounts of £50 to £60 per month are frequent, and even £150 per month is not unknown for miners working on contract. These high wages stimulate the gambling instinct of the miners, and have a good deal to do with their moving about from mine to mine at frequent intervals. Besides which, miners in this country are not usually very thrifty, and the big cheques they sometimes earn tend, in some cases, to irregularities of life which accentuate the evils of miners' phthisis. Every effort is now being made to keep down the fine dust, which is the cause of miners' phthisis, and to secure good ventilation in the mines. It cannot be said that every factor in the problem is thoroughly understood as yet, but a careful study of the causes leading to miners' phthisis and of the most effective measures is now being carried out, and there is every hope that the mines of the Rand will, at no distant date, be made as healthy to work in as any mines in the world.

The high wages paid to miners have inevitably affected the wages paid on the surface. With more settled conditions, lower railway rates, and a gradual reduction in the cost of living, it seems likely that the cost of white labour will in time become lower.

Considering coloured labour, it is now paid for at very high rates. From the commencement, the mines of the Rand have always been short of native labour. In 1892 the number employed was 29,500, and last year the average number was 189,912. In spite of this large increase, the demand caused by the expansion of the industry has always been in excess of the supply. Attempts have been made from time to time to secure co-operation amongst those in control of the mines, whereby the wages paid to natives and the cost of recruiting might be kept with reasonable limits. So far, however, such efforts have been unsuccessful, and the result has been a wild scramble for native workers and consequent high wages and high recruiting fees. The recruiting fees at one mine to-day average 7.215d. per shift worked, whereas at another mine, which is more popular with the natives, they are only 2.997d. per shift worked. When perhaps sixty thousand shifts are worked per month on a mine, it will be seen that the difference of 4.218d. per shift becomes a serious item. Probably the natives are employed, on the average, more efficiently than ever they were before, which is to the good. There is no doubt, however, but that a mutual understanding amongst the financial houses controlling the industry would result in a great reduction in expenses under this head.*

Looking at labour generally, apart from its direct cost, there is room for economy by using it more effectively, and by better organisation and better supervision. Labour may still, in some directions, be economically replaced by machines and by mechanical appliances. This is an aspect of the reduction of working costs which is now receiving very careful attention, particularly in the direction of substituting machine drilling for hand drilling in stopes, and also in introducing improved methods of underground haulage.

With regard to stores—coal, explosives, and all kinds of materials used on mines—there is a hope that the railways will ultimately be run on business principles, and that rates will be reduced, in which case the mines will gain considerable benefit. It is to be feared that not much advantage is likely to accrue, as far as the mines are concerned, from the establishment of local factories, though there might be some slight gain here and there. Economies are possible from the more efficient use of stores, especially coal and explosives, which are the two principal articles of consumption. The supply of electric power from central stations, of which several have been erected, will tend to reduce the cost of power on the mines.

In spite of disturbing factors, there is room for hope that conditions will gradually improve, and that, while there seems to be no reason to expect any sudden or large reduction of working costs, yet small reductions will be made from time to time, which, in the aggregate, will amount to something considerable. So that, as the richer mines become exhausted, it will be possible to work ores of lower and lower grade, and in this way the existence of profitable mining operations on the Rand and surrounding districts will be prolonged indefinitely.

*Since this article was written, the agreement in question was effected.

RAND MINING IN PICTURE



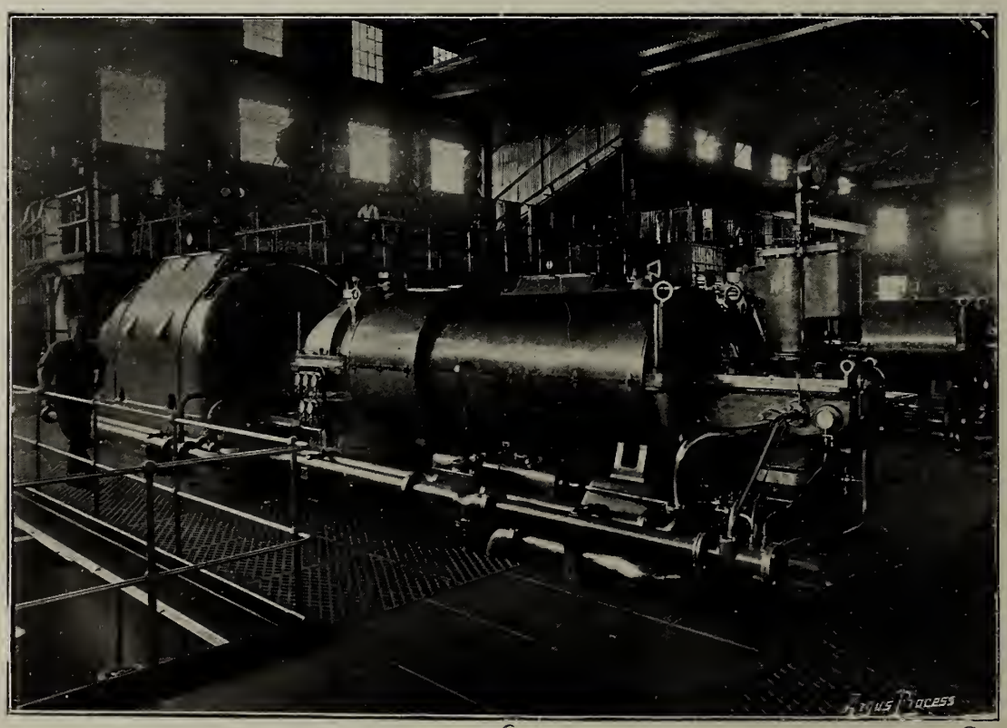
Crown Mines New Mill

Rand Mining in Picture

ROBINSON GROUP *(Continued)*



Cam Shaft Floor, Randfontein Central 600 Stamp Mill



Power House, Randfontein Central

Free Trade and Protection in South Africa

RHODES *v.* CULLINAN

By SAMUEL EVANS

PUBLIC men may be divided into three classes according to their views on the tariff question: (1) Mercantile Protectionists, (2) Scientific Protectionists, and (3) Free Traders. The man in the street, most newspaper editors, and nearly all politicians are either Free Traders or Mercantilists. As regards the fundamental principles involved, Scientific Protectionists, like List and Cary, agree with Free Traders, like Ricardo and Mill; Mercantile Protectionists disagree with both. Perhaps the most striking difference between Scientific Protectionists and Free Traders, on the one hand, and Mercantilists, on the other, is this: Free Traders and Scientific Protectionists everywhere agree that "the exclusion of foreign goods cannot increase the demand for labour in the importing country, and will, in fact—in so far as the goods excluded have to be produced at greater cost at home—decrease it." Mercantilists deny this.

In South Africa we may take Rhodes and Sir Thomas Cullinan (Chairman of the Commerce and Industries Commission) as representatives of these two schools.

Sir Thomas is an ardent and enthusiastic Mercantilist—excepting as regards diamond cutting. It is clear from his public speeches and his pronouncements at the sittings of the Commerce and Industries Commission that he has been immensely impressed by the specious arguments and plausible assertions of the politicians, newspaper editors, and pamphleteers, who in most cases are paid to voice the views of the Protectionist manufacturers of the United States, Canada, and Australia. As a result, he has become a profound believer in State intervention, through tariffs and in other ways, as a means of increasing the numbers and wealth of the white population of South Africa.

He gave the Transvaal Government, and has given the Union Government, the same advice as Colbert gave Louis XIV. in the seventeenth century, and almost in the same words. The gospel which Sir Thomas is never tired of preaching may be summed up thus:—

"Unsatisfactory conditions will prevail in South Africa until the country is producing all its needs. The remedy is to build up industries, and that can only be done by making the tariff high enough to keep out foreign-made goods. Imports diminish employment in South Africa and take money out of the country. By manufacturing here what has hitherto been imported, we shall keep the money in the country and provide additional work for South Africans."

That, I think, is a fair statement of Sir Thomas's views. It is true that as chairman of the Premier (Transvaal) Diamond Mining Company, he is in a somewhat incongruous position, as his line of argument, carried to its logical conclusion, must mean shutting down the Premier and every other diamond mine in South Africa. Perhaps he has not studied that side of the problem, or perhaps he thinks the sacrifice of industries dependent on international trade, such as diamond mining and ostrich farming, is justifiable in the interest of South Africa as a whole.

Rhodes, like Bismarck, was a Free Trader who was not fastidious as to the means he employed to attain his ends. In order to secure the support of the Bond to his policy of expansion in the north, he agreed to uphold the claim of the farmers of the Cape to Protection for their wheat and wine. However, he never pretended that that, or any other kind of Protection, was a virtue. He had no illusions on the tariff question. He had as thorough a grasp of the theory of international exchange as Bastiat. He knew that taxing imports would handicap the white man in his competition with the Kaffir in South Africa. He knew that protective duties hampered those businesses that are profitable in order to bolster up those which are not. The other day (March 29th last), Sir Thomas Cullinan tried hard to impress on the members of the Union Parliament the importance of encouraging wool and textile industries in this country. In 1885 and 1886 certain members of the Cape Parliament proposed that steps should be taken to encourage cotton and woollen manufactures. Rhodes actively opposed the proposal. "He would," he then said, "oppose anything that pandered to Protection." Rhodes always spoke with contempt of efforts to establish in the Cape what he called "bastard industries"—industries which would not exist were it not for the tariff. He consistently opposed the imposition of duties for the purpose of shutting out British goods in order to encourage the colonists to make "bad clothes and bad boots at the expense of the general community." In a word, his policy on the fiscal question was diametrically opposed to that of the chairman of the Commerce and Industries Commission.

Which of these two policies is going to prevail in South Africa in the long run?

I venture to suggest that Rhodes foresaw the advent of Sir Thomas and other champions of high tariffs. He, therefore, forestalled them by erecting across their path a barrier against which they and all the forces of the manufacturers' associations, of the National Union, and of all other Protectionist organisations in South Africa will tilt in vain. For a great many years Rhodes worked hard to induce the British Government to incorporate in the Rhodesian Charter a provision to the effect that the Customs duties on British goods entering Rhodesia should not at any time exceed those which then prevailed

Rand Mining in Picture

ROBINSON GROUP *(Continued)*



600 Stamp Mill, Randfontein Central



Electric Power Station, Randfontein Central



Cyanide Plant, Randfontein Central

in the Cape. As regards a considerable portion of Northern Rhodesia, the Berlin Act of 1885 and the declaration of the Brussels Conference of 1890 had already fixed a ten per cent. limit to duties on all imports excepting spirits. On the 22nd of May, 1894, the secretary of the British South Africa Company, at the instance of Rhodes, addressed a letter to Lord Ripon, then Colonial Secretary (British Parliamentary Paper, H.C.177), and from which I extract the following :

"Mr. Rhodes thinks that it is a wise provision that the Customs duties on British goods (imported into the Chartered Company's territories) should not exceed the present Cape tariff, which is a reasonable one, and is imposed for the purpose of revenue, and not for protection, and not with the view of making prohibitive tariffs against British manufactures. He thinks it is a pity that when Responsible Government was given to the Colonies provision was not made at the time that duties imposed on British goods should not exceed a certain amount. Such an arrangement would have been . . . . a salutary check against the introduction of the principles of extreme Protection, the results of which to the ordinary community are, that all the necessaries of life are made infinitely dearer. . . . . Mr. Rhodes . . . . says, in return for the benefits which we have received from the Mother Country, let us make it a portion of our constitution that British goods shall never pay a tariff exceeding the present tariff in force in the Cape Colony. This tariff is not a prohibitive or protective one, but is merely for the purpose of revenue, and under it British goods receive the utmost fair play. Mr. Rhodes wishes this tariff to become, in so far as British goods are concerned, a portion of the constitution of the Chartered Company's territories, *i.e.*, that we shall not have the power to impose a higher tariff on British goods, as that would be in the direction of a protective or prohibitive tariff.

". . . . Mr. Rhodes prefers the clause with the insertion of the words 'British goods,' because it would then bind the country in the future never to put an excessive rate on British manufactures, and leaves, as it should do, the rest of the question open.

"Mr. Rhodes says the provision that our tariff on British goods should not exceed the present Cape tariff was suggested by himself in the interests of the English people, who are daily perceiving that the only return made them by the Colonies and States that they have founded, for all the blood and treasure they have spent, is that the present occupants place hostile and prohibitive tariffs against their goods, thereby removing the only existing benefit to the British manufacturer. Mr. Rhodes wishes to guard against a repetition of this in the Chartered Company's territories. . . . .

"It is to be observed that the proviso proposed by Mr. Rhodes . . . . would have had a Free Trade rather than a protective tendency.

". . . . If such a provision had been contained in the first instrument of government it would have had a great effect in shaping the policy of the community, upon which a constitution is now being conferred.

"The provision would no doubt have a great effect upon the future fiscal policy of South Africa. . . . ."

In June, 1894, Rhodes read the statement from which I have just quoted in the Cape House of Assembly, and added, "I shall continue to use my influence to insist on my offer being carried into effect. I mean to fight until Her Majesty's Government give in." In addressing the shareholders of the British South Africa Company on January 18th, 1895, he explained at great length why he wanted a provision in the constitution which would make the adoption of the policy of Protection in the Chartered Company's territories for ever impossible. He said that it was really a Free Trade proposition intended, in the event of a Protectionist wave coming over the inhabitants, to prevent the adoption 'of this folly of Protection," which, when once adopted, could not be got rid of owing to the vested interests that it created. "The United States," he said, "have adopted this folly of Protection—they cannot get rid of it now. . . . . Many of our Colonies have found out the folly of Protection, but they have created a bogey which they cannot allay, because the factories have been created, the workmen have come out there, and they are only kept going by high duties ; and a poor Minister who tries to pass a low tariff knows perfectly well that he will have his windows broken by an infuriated mob. The only chance for a colony is to stop these ideas before they develop, and taking this new country of ours, I thought it would be a wise thing to put in the constitution that the tariff should not exceed the present Cape tariff, which is a revenue and not a protective tariff. . . . . I thought if we made that a part of our constitution in the interior, we should stop the creation of vested factories, a most unfair treatment of British trade, and a most unjust thing to the people of a new country. . . . ." He added that when it came to the formation of a Customs Union, the existence of this clause in the constitution of Charterland would govern the policy of the rest of South Africa.

Rhodes persisted in his policy until the British Government yielded, which they did in the second half of 1898. (See clause 47 of the Rhodesian Order in Council of October 20th, 1898.) Referring to his victory in a speech delivered at Claremont on July 20th, 1899, Mr. Rhodes said he had had a great battle over how the clause should be worded, and he had won. Proceeding, he observed : "Having adopted that principle, it is the constitution of the country, and I see no possibility of its being changed. It is a sacred thing. . . . . Great Britain will have a perpetual market for her goods until the constitution of Rhodesia is changed, and you must remember there is one thing which human beings never change, and that is the sacred constitution on which their country is founded. It was the sacredness of the constitution of Washington which had brought about the American War, and which appealed so powerfully to American citizens. I feel sure that when federation in South Africa is arrived at, this idea of an upper limit for British goods will remain in the constitution of the federated States, and will be their return to the Mother Country for the blood and treasure she has spent in their behalf."

In time, the whole of British South Africa is bound to come under one Government, possibly sooner than most people think ; and the probabilities are that the Rhodes anti-Protectionist provision will be embodied in the constitution of the united country, simply because South Africans, when they have thought the matter out, will conclude that Rhodes is a safer guide than the high priest of high tariffs.

RAND MINING IN PICTURE



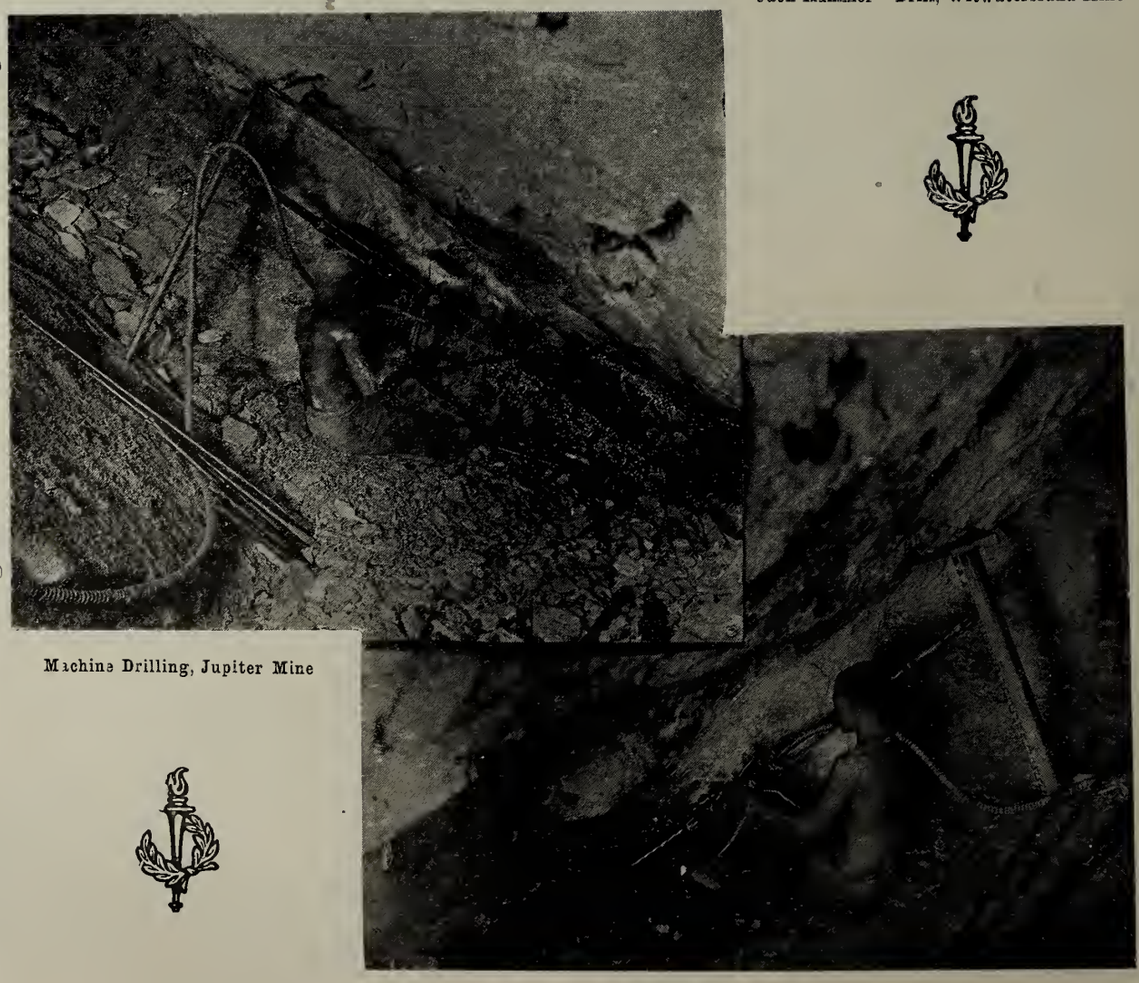
West Rand Unified Mill

Rand Mining in Picture

SOME TYPICAL UNDERGROUND VIEWS



"Jack Hammer" Drill, Witwatersrand Mine



Machine Drilling, Jupiter Mine

A New Aspect of Mining Economics

A Thought-compelling Contribution to the Discussion of the Rand's Biggest Problems

By WILLIAM CULLEN
(Manager, Dynamite Factory, Modderfontein)

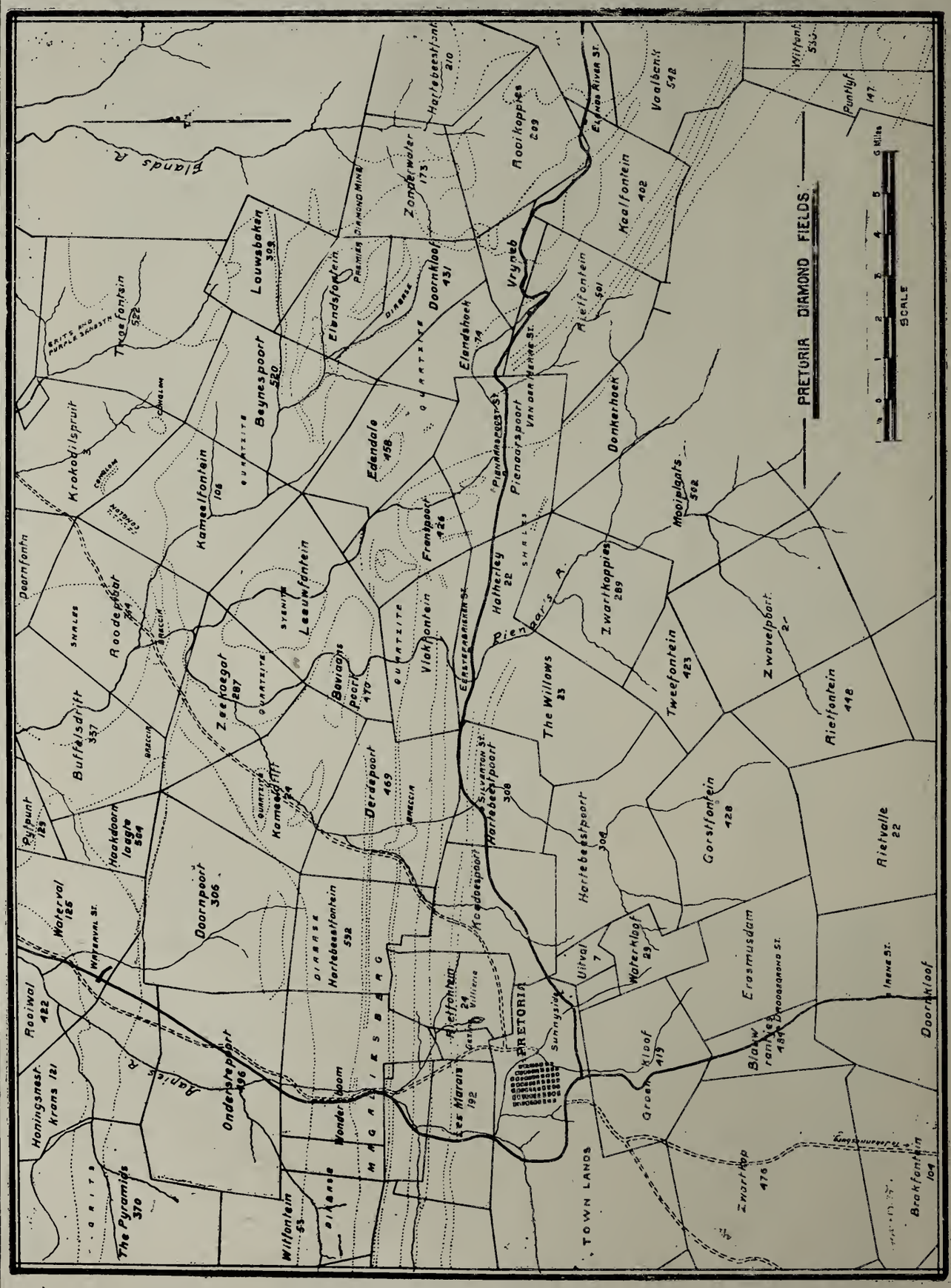
WITHIN the past few months the humanitarian—if I may so term it—aspect of the mining industry has been receiving a great amount of attention in both our technical and daily papers. As a result, the public's conscience has been awakened, and the Phthisis Bill which is now before Parliament is a concrete manifestation of the fact that the question has got beyond the academic stage. I might say in passing, however, that it has remained far too long in that stage. Broadly speaking, the Mining Regulations Commission and the more recent Phthisis Commission have not discovered anything startlingly new, but they have served the very useful purpose of correlating and co-ordinating an immense mass of semi-digested material and boiling the whole down to one or two broad conclusions. It surprised no one who knew anything about the circumstances to learn that over thirty per cent. of our miners had contracted phthisis in a more or less acute form and that our accident rate was among the highest in the world. Now, even under the most favourable circumstances, mining can never be as healthy or as safe as, say, bricklaying, but it is admitted by all that present-day conditions leave much room for improvement. I shall, therefore, be very much surprised if, in the near future, great improvements in working conditions are not effected. But there is one aspect of this subject which has hitherto received practically no consideration. I mean the native aspect. No one can tell to-day to what extent natives are affected by phthisis, and no one has any idea of how many die in their kraals from it. Admittedly, the statistics are difficult to obtain even within the borders of the Union, and outside of it it is well-nigh impossible. That they must be affected stands to reason, for it is they who have to do the hard "graft," and it is mainly they who are exposed to the dust. Then, with regard to the accident and mortality rate, there is undoubtedly a tendency to look at it from the point of view of the whites alone. What I mean is this, that the loss of, say, ten white lives is looked upon as a much greater calamity than the loss of a similar number of native lives. This is, of course, understandable and perhaps natural, but is it right? I do not think so. Most of us are apt to forget that, notwithstanding all the rubbish we hear about white labour and making this a white man's country, the native is the foundation stone of our entire economic fabric. Take him away, and not one of us would be working in Johannesburg to-day. I am a sincere believer in the doctrine of white labour, but I have tried it in practice with most lamentably discouraging results, and I know that my experience is general and not isolated. What I am about to say in developing this idea will be most unpalatable to many who have not taken the trouble to think things out to their logical conclusions, but with that I am not concerned at the moment. Now, the native, as we know him, seldom works longer on the mines than twelve months. He returns to his kraal for a more or less lengthy holiday, and in most cases during his holiday shakes off the ill-effects of working underground. With the white man it is different; only a few imitate the native, and I believe that I am right in saying that these men feel benefited in health—they last longer. In passing, might I suggest that if it could be arranged for underground men to be given a surface job for three months out of the twelve, the ravages of phthisis might be reduced. I see the difficulties quite well, but it strikes me that this suggestion is worth a trial. The next point is even more

RAND MINING IN PICTURE



Apex Colliery Pit Headgear and Screening Plant

A Promising Diamondiferous Area



Map showing Pretoria Diamond District

important. Some people look upon the native as an undisciplined savage, incapable of being more than a hewer of wood or a drawer of water. The general answer to that question is, of course, the miners' strike, which did not paralyse the industry as much as was expected. Of course, I know we had the Chinese then, and this complicated the issue, but, generally speaking, my experience is that the native is capable of much more than is generally supposed. Many underground men know this full well. He responds to kindly treatment, is very amenable to discipline, is a quick learner, and dependable if shown with patience what is expected of him. In other words, could we not make much more use of the native underground than we do now? I approach the question purely from the humanitarian point of view, for, as I have said already, the native has always his kraal to fall back upon. The adoption of my suggestion would, of course, mean comparatively high wages for a selected few natives and a reduction in the number of white men underground. Indeed, only the best men would be kept underground; they would run less risk from the dust, for I conceive that the natives whom I have in my mind would run the drills; some even say they run them to-day. This arrangement should please everybody, for the inefficient miners, of whom we hear so much, would be eliminated, the good ones would all earn good money, and I conceive that the natives, under the new conditions, might remain longer at their work than twelve months.

We have heard a great deal recently about our high accident rate on the mines. Some, myself among the number, say that the constant changing of the labour force is one of the predisposing factors; others the reverse. I believe that there is truth in both views. The old miner takes risks, and the new hand is wanting in understanding. If chairmen, consulting engineers, and managers are to be believed, the arrival of batches of fresh and inexperienced natives frequently spells reduced profit, and I think they are right. After three months their efficiency is higher, profits rise, and I assume, though it would be difficult to prove, that the accident rate goes down. If the native could be persuaded to stay for three years, he would be very good indeed, and he would have learned in that time to avoid doing certain things which are attended by risk. He will not stay for that time, however, without his womenkind, and it would be unnatural to expect it. I, therefore, make another suggestion: would it not pay the mines to have, say, ten per cent. of their labour force on the "strength"? I can say from experience that it will pay, and, indeed, the proposition is so obvious that there can only be one answer. I go even further, and assert that it would help in the solution of some social problems about which we are all apt to become hysterical at times. If the foregoing premises are right, then it follows that, so far as the accident rate is concerned, the Chinese period should have shown the lowest accident rate which we have ever had. Statistics are difficult to obtain, and, in any case, they are complicated by a number of extraneous circumstances, but I know I am right in saying that the accident rate of the Chinese was always much lower than that of the natives, notwithstanding the fact that a large proportion of the gaolbirds of China were foisted on us. The Chinese experiment had never a proper chance, and I, for one, am strongly in favour of trying it again—under proper safeguards, of course, and with, say, ten per cent. on the "strength." Again, on humanitarian grounds alone, the retrial of the experiment would be justified, and that we shall be driven to this course in the long run I have not the slightest doubt. At the moment, we have an abundance of native labour for reasons which everyone knows, but if next season is a good one, we shall again be faced with a shortage, and this is as certain as the fact that next summer is coming.

RAND MINING IN PICTURE



New Modderfontein Mill under Construction



Paid Up Capital - £8,800,000

Reserves - - £3,000,000

Number of Employees - 62,000

Works covering aggregate area of about acres 270



Machine Factory: Output last financial year **92,186** machines and transformers of a total capacity of **2,385,896** H.P.

Turbine Factory: Output during same period **284** steam turbines, total output **441,467** H.P.

Apparatus Factory: High and low tension apparatus, fans, measuring instruments, etc., number of electricity meters, manufactured annually **300,000**

Cable Works: Copper consumption during last financial year **30,000** tons

Lamp Factory: Capacity .... **100,000** metal filament lamps **daily,** besides carbon lamps

Locomotive Factory **Automobile Factory**
Rubber Factory **Insulators Factory**
Heating & Cooking Apparatus **Typewriters**
Synthetic Jewellery

SOUTH AFRICAN AGENTS:

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Electricity in Alluvial Tin Working

Prize Essay by W. A. MOORE, A.M.I.E.E.

THERE are few industries of the present day in which electricity does not play an important part, and one of the most recent examples in connection with the South African mining industry of the utility of this most adaptable form of energy is to be seen in its application to alluvial tin recovery operations.

A plant designed for this purpose has recently been installed in the Waterberg tin mining district, and although it has been in operation for a comparatively short time, it has already given promise of great future usefulness. Briefly described, it may be said to consist of four parts, viz.: Central generating station, power transmission lines, service pumping stations, and hydraulicing pumping station.

An interesting feature of the generating station, in view of the recent unfortunate experience with gas engines at the Johannesburg Municipal Power Station, is that the main electric generator is driven by a gas engine of about 500 brake horse power, supplied with gas from producers using bituminous coal, with every degree of satisfaction. This fact should help to dispel the prevailing unbelief among local engineers in gas engine plant as an economical and reliable power producer at high altitudes. The engine is of the "pressure" type, *i.e.*, it does not depend entirely on its own suction to obtain its charge of gas, as its charge is assisted into the cylinder by a small auxiliary centrifugal fan, independently driven. The electric generator, driven from the gas engine by laminated belting, is of the three-phase type, generating current at a pressure of 550 volts. This pressure is transformed at the generating station to 3,300 volts, and at this latter pressure the current is passed out to the outgoing transmission lines, travelling along these conductors for a distance of about five miles to the source of water supply. Here the service pumping station is situated in the heart of an immense vlei, covered with scrubby bush, where the duiker can occasionally be seen on the way to quench its thirst in the pools of the low-lying marshes, and where guinea fowl are plentiful, if somewhat shy of the sportsman. At the pumping station the pressure of the line current is transformed down to 500 volts and drives an electric three-throw plunger pump, which raises the water from a well sunk in the vicinity of the pumping station and forces it along the pipeline a distance of five miles against a head of approximately five hundred feet. This water supply is not used directly for hydraulicing, as it is in part utilised for general mining purposes, and is therefore discharged into a large tank erected a little above the level of the battery house, contiguous to which is the generating station. From this tank water is pumped by an electric three-throw ram pump through a pipe line running almost vertically up the face of a rugged mountain, near the top of which, some thousand feet above the battery house situated in the valley beneath, is the site where hydraulicing operations have been commenced. At this point the pumped water is discharged on the surface and directed by open channels to flow into a small dam, which has been constructed to catch the residue effluent after the extraction of the alluvial tin, and also to act as a storage reservoir from which the make-up water and pulp are re-pumped in a continuous cycle of operations

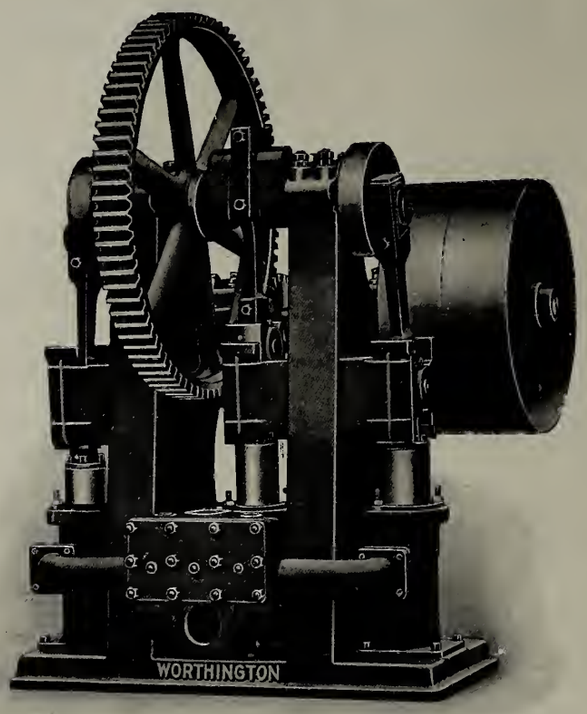


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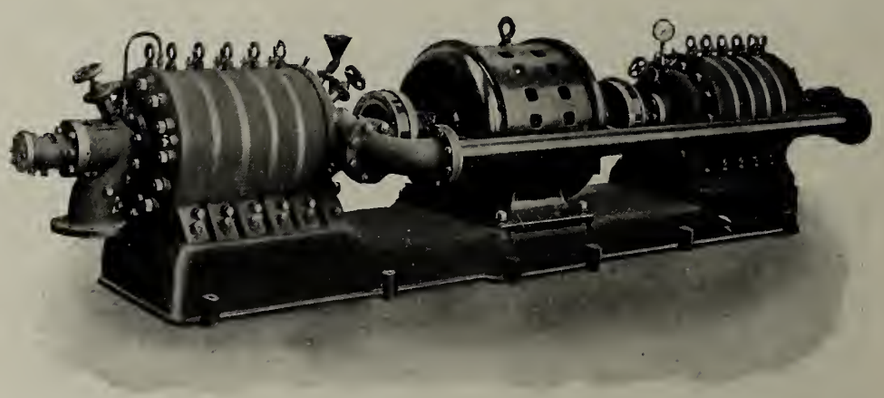


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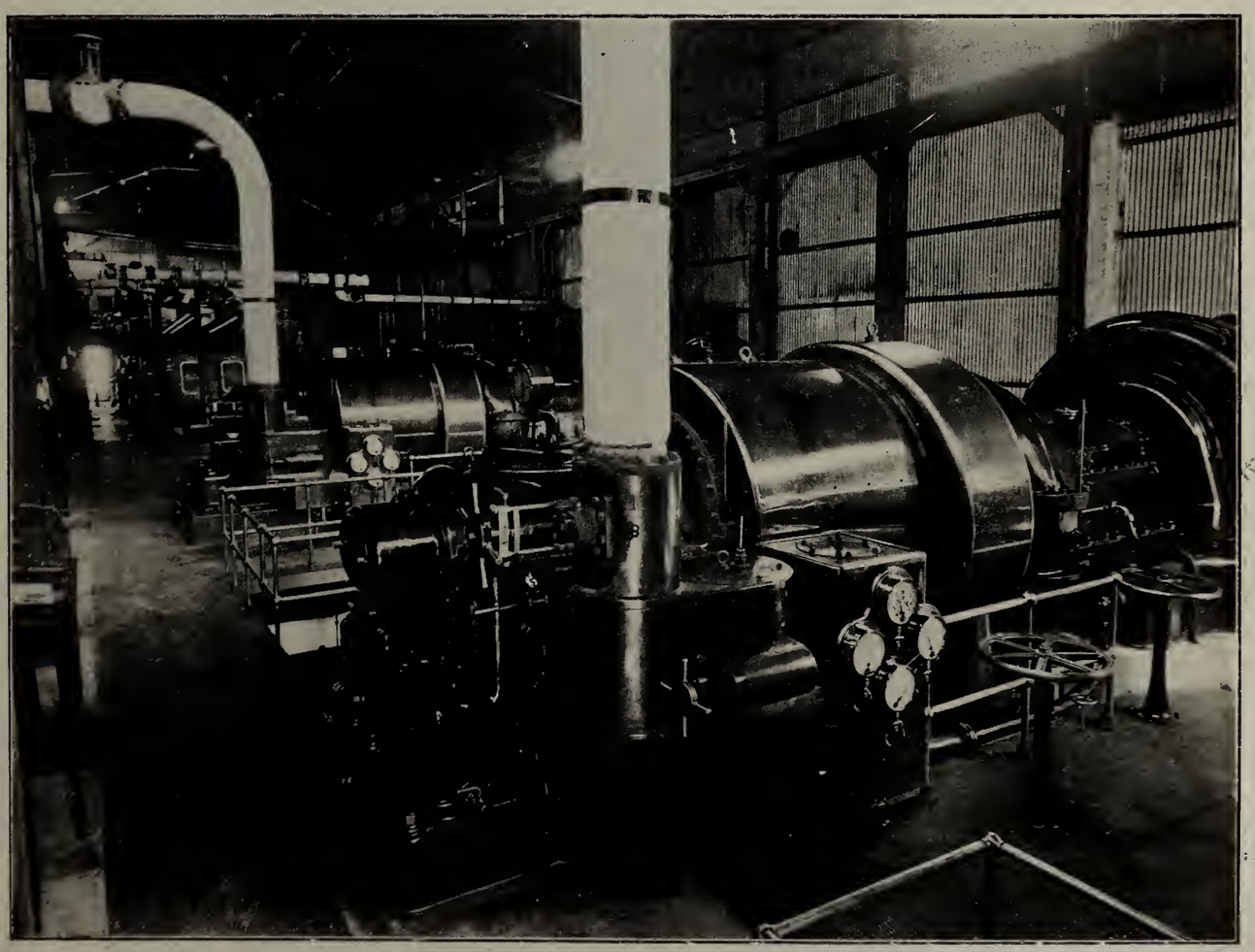
during hydraulicing. Alongside this dam is situated a transformer and pump house, receiving its power by overhead 3,300-volt lines from the generating station below, and transforming it to 500 volts for driving the hydraulicing pump motor. The pump here is of a special design suitable for its peculiar duties, and is of the multi-stage centrifugal type, with pressure clear water glands, which effectually prevent the wear and tear of the bearings which would otherwise ensue owing to the very gritty nature of the pulpy water with which this pump has to deal. The discharge pipe is of a telescopic nature, as constant changes have to be made in its length when varying the position of the monitors.

In the description of an electric plant such as this, where overhead conductors are carried across very mountainous country subject to frequent thunderstorms during the summer season, sometimes of a very violent nature, a few words on the various protective devices adopted to safeguard the generator, motors, and the apparatus generally should be of interest. All motors on the system are fitted with electro-magnetic overload cut-outs and no-voltage release coils, and all the overhead lines are protected at both ends by "Wurtz" type non-arcing arrestors, The lines entering the generating station are fitted with choking coils and electro-static horn arrestors to divert and dissipate any high-frequency charges which may come along the line due to lightning or inductive surges.

It will be readily seen, on consideration of the requirements of such a scheme, the constant changing of the site of hydraulicing as the surface soil gets worked out, the nature of the contours, and location of the water supply, how advantageously and economically electricity adapts itself to all the conditions, owing to its peculiarly "elastic" properties. The maintenance costs of running an electric plant of this description may be taken as practically the running costs incurred at the central generating station, as the cost of the upkeep of the pumping and transformer stations is very low, due to the fact that constant supervision by skilled workmen during running is not required at these points.

A point of considerable importance in connection wth the commercial efficiency of the plant as a whole is the great advantage from an economic point of view of having a reliable telephone service installed between the various pumping stations and the generating station, as in the event of anything giving trouble either at those stations or on the lines, communication can be immediately set up between the point of trouble and the central station, and the defect repaired with a minimum of time wasted, thus obviating the stoppage of working operations for a lengthy period, with the consequent financial losses which this would entail.

ELECTRIC POWER SUPPLY ON THE RAND



Johannesburg Municipal Power Station, Interior

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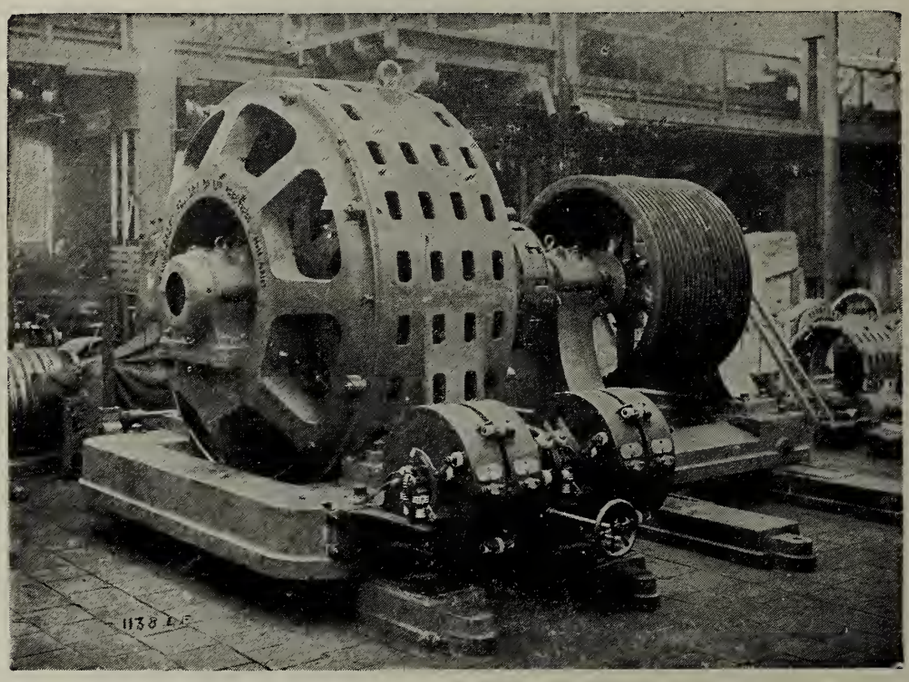
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Manufacturing Developments in the Engineering World

Advent of the "Cascade" Motor :: The Humphrey Gas Pump :: Innovations with Vast Possibilities

IT is interesting to note that the Sandycroft Foundry Company, Ltd., of Chester, England, who for the past seventy-five years have been manufacturers of almost all classes of mining machinery, and one of the oldest firms represented out here, have lately placed on the market certain new lines, both from a mechanical and electrical standpoint.

In the first place, they have placed before the mining and engineering world a new type of three-phase "Cascade" induction motor, which has many interesting and useful characteristics, on which many papers have been written and many articles in the engineering press have appeared. For actual details in construction and design, we would draw our readers attention to a paper by Mr. L. J. Hunt, March 19th, 1907, Inst.E.E., and papers by Mr. M. I. Williams-Ellis, June 15th, 1910, Ass.M.E.E., and April 20th, 1912, South African Institute of Engineers.

The "Cascade" motor is now being used for all classes of work, such as winding, pumping, compressing, hauling, driving mills, etc., complete plants having been supplied for mines and works in England, America, India, Africa, Spain, Siberia, etc., and in all cases are giving every satisfaction. The two-speed "Cascade" motor gives a satisfactory solution for a variable speed induction motor, and has been already applied with great success for the driving of compressors, winding engines, fans, pumps, etc. Not only are motors with two efficient speeds being installed, but motors with three efficient speeds are now being erected. Some of the claims made are :—

(1) Perfect control of starting torque and speed.
(2) High efficiency and power factor.
(3) Absence of slip-rings (single-speed machines).
(4) A practically indestructible rotor-winding wound for very low voltages.
(5) High efficiency at variable speeds.
(6) Full load current for full load torque (two-speed machine).

It is highly satisfactory to note that the Sandycroft Foundry, besides keeping up their reputation as first-class manufacturers of all classes of stamp battery parts, etc., and, besides their many other branches, are still building large steam winders, two having just been supplied to some Indian mines of 5,500 b.h.p. to wind from a depth of 3,700 feet, raising a load of 34,800 lbs. at a speed of 3,000 feet per minute. Drums, 20 feet diameter. Fitted to these engines are the "Gott" patent combined controlling gear and depth indicator.

One of the most novel forms of plant manufactured by the Sandycroft Foundry Co. is that of the Humphrey gas pump, which is being placed on the market out here chiefly for irrigation schemes. In this form of pump there are no moving parts except the valves, the water itself acting as the piston.

The upkeep is therefore very small, while the running costs when dealing with large volumes at low lift is, we understand, far lower than any other system.

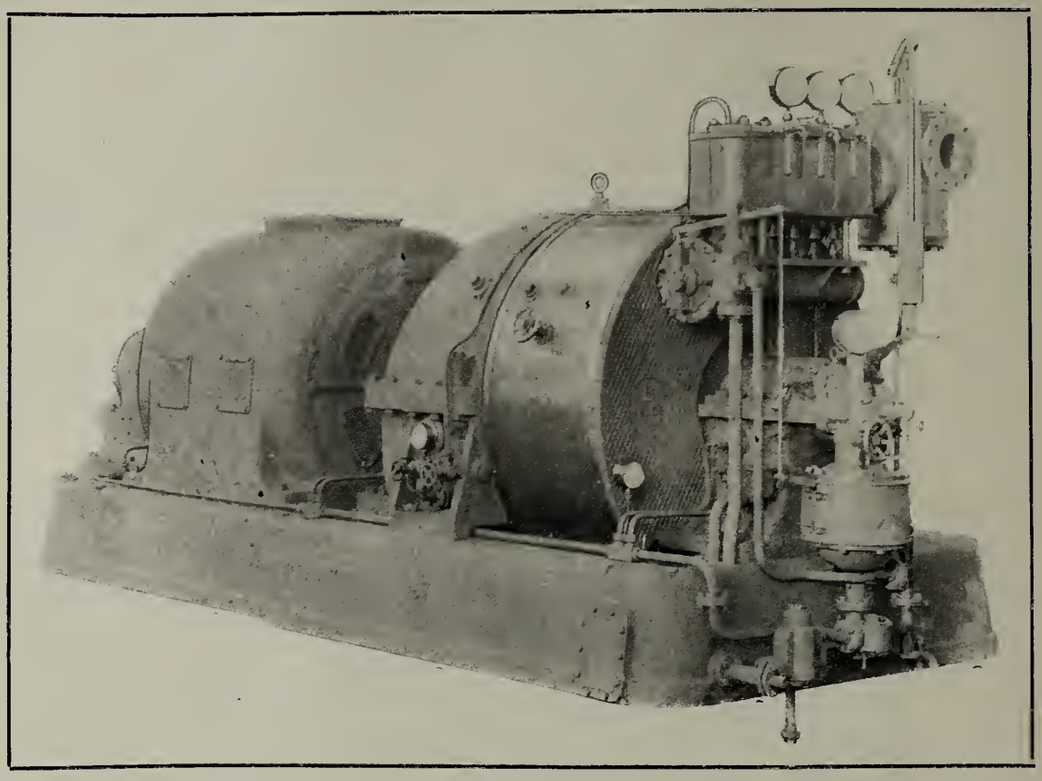
RAND MINING IN PICTURE



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Resident Mechanical and Electrical Engineers on Mines

A Review of their Positions and Responsibilities on the Rand

By KENNETH AUSTIN, M.E.
(Hon. Sec., the Association of Certificated [S.A.] Mechanical Engineers)

SOME years of general experience with the operation of the Mining Regulations, which require that every engineer in charge shall be certificated, has shown that the alteration made in the law several years ago has been of the greatest value to the industry, has increased the safety of all those "who go down to the mines in skips," and has generally raised the whole character of all those in whose charge the mechanical and electrical work of a mine is placed.

The very high standard set by the examination commissioners appointed by the Mining Department is evidence, and a guarantee, that only the best trained and educated men (who sit for the whole examination) are permitted to possess the highly valued certificate of competency.

Those who are intimately acquainted with the personnel of the mines of the Witwatersrand and Barberton districts must admit that it is one of the finest examples of the advantages of combined practical and theoretical training. The whole of the mines of the Transvaal are generally "engineered" with men drawn from the front rank of every branch of engineering from all parts of the world; but many of the men who hold the highest positions have been wholly trained in the colleges and workshops in South Africa. There is little or no room on the mines for anyone who has not had a practical training; the simple "bookman" has to train himself to do the most laborious work before being entrusted with any official position.

The examination set for mechanical and electrical engineers is a good test of a man's reading and study, but, as far as the mines are concerned, the best certificate is still considered to be that of steady, capable service. These men are continually engaged in dealing, every day, with problems and troubles which arise, to prevent loss of life, and damage to property.

The Mining Regulations which existed prior to December, 1911, have been recently altered in order that the great advance made in the distribution and use of electrical current should be provided for. The rules recently made by the Commission of Examiners for the certificate of competency provide that every candidate shall have passed through a satisfactory apprenticeship, and that he must obtain at least fifty per cent. of the marks allotted to: (i.) Legal knowledge; (ii.) strength of materials; (iii.) strength of materials and design of structures; (iv.) power plants; (v.) driven machinery and appliances; (vi.) electro-technics; (vii.) mining plant.

The newly instituted certificate of competency in electrical engineering involves an advanced examination in electro-technics in addition to the above.

At the present time all those who sit for the full examination are equally treated, and the efforts of the Commissioners have produced the happiest and best results for the mining public, as well as for the mechanical and electrical engineers; but there is, unfortunately, a very serious matter which should be dealt with without delay.

Under one clause, the regulations make it possible for certain persons to obtain a certificate, under conditions (which are only "service" conditions), without having to sit for the full examination.

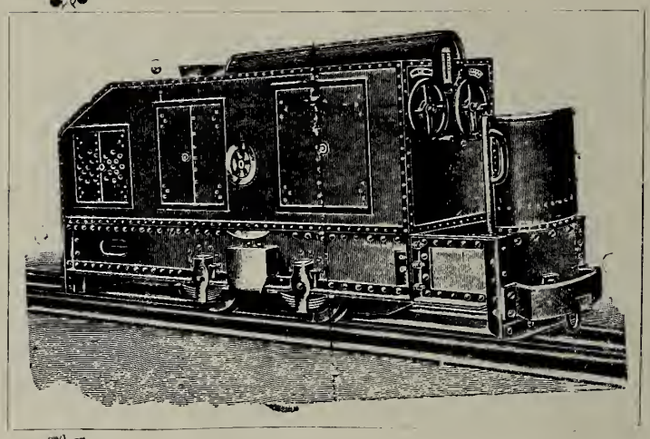
This is clearly against the spirit of all progressive legislation, and it is generally hoped that a change will immediately be made whereby every person, irrespective of the position he may have occupied in Europe or elsewhere, will be compelled to sit for the full examination in exactly the same manner as any young South African engineer, whose fortune may not have been so great as the new-comer, but whose knowledge and experience may be greatly in advance of that possessed by the more favoured person.

The Association of Certificated Engineers is at present endeavouring to obtain what is obviously elementary justice, and it desires, above all things, that nothing shall be done to reduce the standard of the "certificate of competency" for mechanical and electrical knowledge.

The general current complaint about the inefficiency of labour does not apply to the mechanical or electrical workers. The advance in the education of mechanical and electrical engineers during the last decade has been enormous. The efforts of technical men, such as Messrs. John Orr (professor and head of the engineering branch of the Transvaal School of Mines), F. H. Mitchell (electrical branch), A. C. Whittome, M.E. (whose private effort has contributed very largely to the safety of the mining public and the efficiency of engineers) have made a very great change, and the whole community has reaped considerable advantage from what has been done, and is now being done, for the advancement of mechanical and electrical education: The latter, with the advancement of professional and social interests, was the prime object for the foundation of the Association of Certificated Mechanical Engineers in 1910.

Gewerkschaft Schalker Eisenhütte

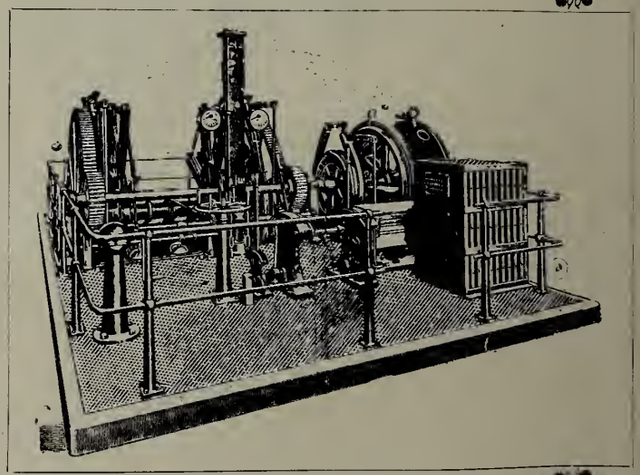
Iron Works and Foundry, **Gelsenkirchen-Schalke,** GERMANY

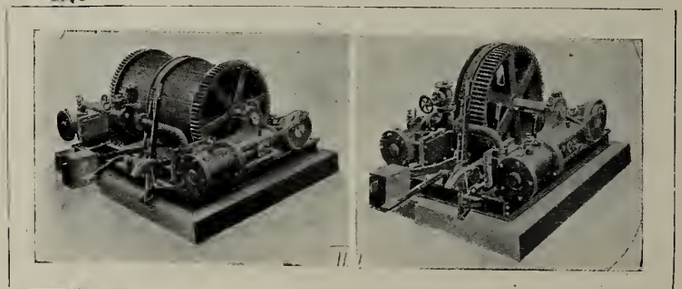


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Looking back upon the inventions made in all branches of the profession, there is much of which mechanical engineers can be proud, but the future has just as much in store as ever; the mechanical and electrical engineer will strive to reduce the total amount of human toil, and to save values of the materials which pass through their department, to such a degree that present costs will be lowered in the future. Much of this saving will be counterbalanced by high mining costs, but even in this department there remains much to be done, to reduce the costs of drilling, transport, loading, hoisting, and the various mechanical and electrical processes which are conducted on the surface of the mine and charged to "mining" account.

There is a remarkable demand for the man of energy and practice. Many of the mistakes of estimating, and in the costs of erecting and working of plants, have been due to the rule of the pure theorist, who will take the trouble to work out calculations to four decimal places, but who fails to appreciate the necessity of observing the true and full meaning of beginning with small experiments and growing to bigger things by easy, economical, and well-ascertained stages. So much has recently been said about mistakes made by engineers, that it has to be mentioned that the blame, if any, should be allotted in the right quarter. But is there any need for blame?

The great thing which should be realised is that the mining companies have, with few exceptions, got good value for the capital spent, even though the expenditure does not agree with the estimates. It often happens that between the time when estimates were made and the actual execution of the work, conditions with regard to technical treatment have changed, and this should be taken into account. Many an increase of expenditure has resulted in greatly increased facility of treatment, but it is always open to serious question whether such divergence from the original estimate can truly be described as a "mistake." Nothing but organisation of the proper kind, and imagination of the most practical character, will produce the effect of reducing mining costs, from the mechanical and electrical engineer's point of view.

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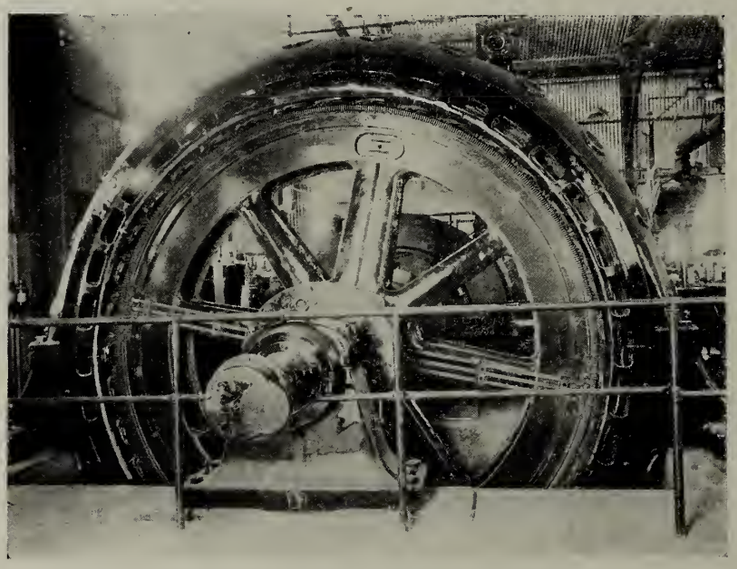
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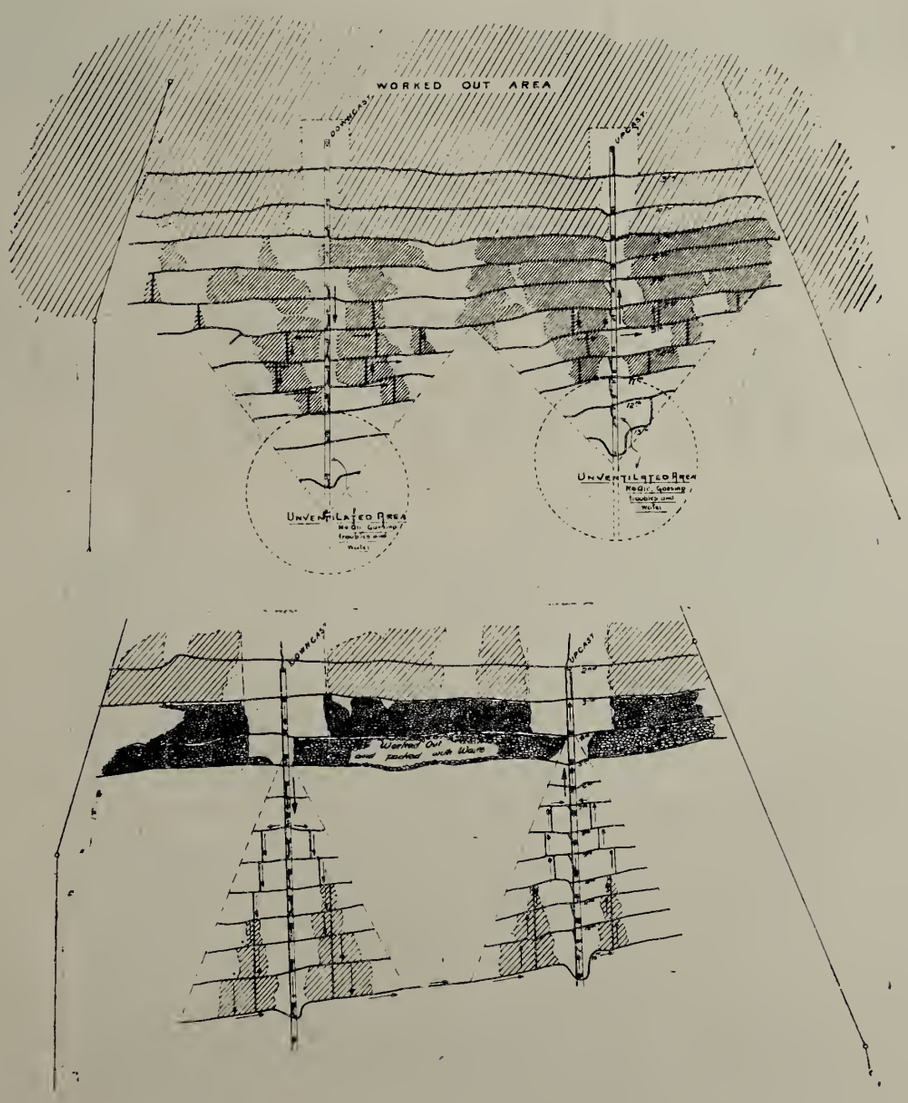
The Ventilation of Rand Mines

Large Number of Fans Employed :: Others to be Erected :: Interesting Figures as to Sizes and Capacities :: The "Square Deal" Underground

THE amalgamation of Witwatersrand mines has enabled the controlling groups to carry out many improvements in technical practice, not the least important of which has been the concentration of work in and around main shafts and crusher stations. It is now freely admitted that the Rand is possessed of too many shafts, and one of the first alterations carried out upon amalgamation down right along the Rand. They are no longer required for purposes of hauling, but the majority of them are maintained in a fair state of order and preservation, and may at some time prove valuable in cases of emergency.

One Consequence of Amalgamation.

Under normal conditions, however, these shafts should prove of marked service and usefulness. One



Old and New Systems of Ventilation in Rand Mining

at the Crown Mines and at other large united properties was the gradual closing down of the older and smaller shafts and concentration of hoisting operations in and around the newer shafts of large capacity. As a consequence, a number of old shafts have been closed advantage of amalgamation which has as yet not secured the recognition it merits has been the improved ventilation conditions resulting from fusion of adjacent mines. Incline shafts have been continued into deeper level ground, and long drives have been carried east



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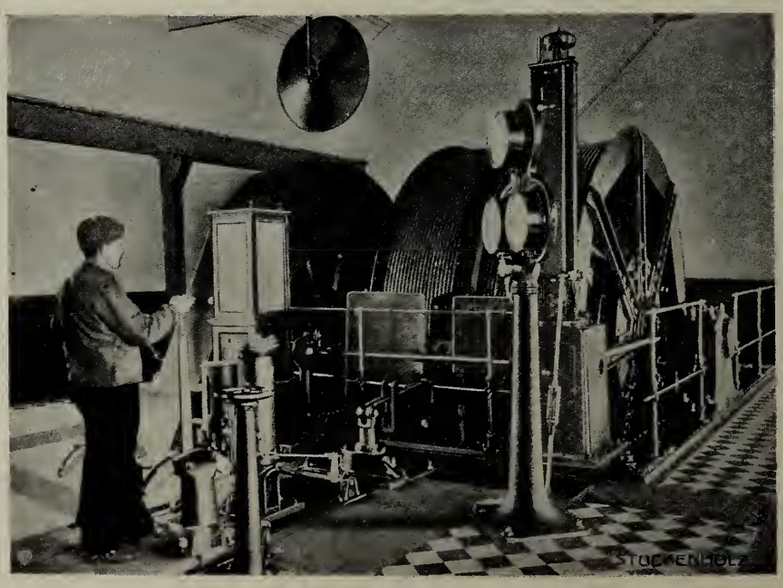
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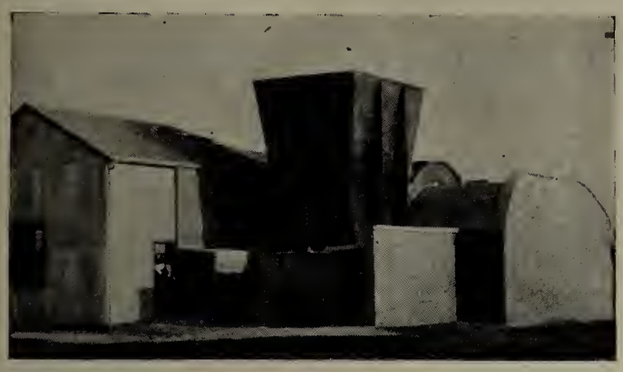
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and west throughout the properties. Naturally, marked improvements have been recorded in both the quantity and quality of air circulating throughout the workings. In regard to idle or little used shafts, the Simmer Deep has made use of the Rudd or central shaft as a water and ventilation vertical. A large Sirocco fan has been



A Sirocco Fan at the Cason Mine

installed, and the shaft can be sealed over, thus making the Milner and Clement downcast shafts.

Similar methods are to be pursued, so we understand, at other mines. There have been brought into amalgamation schemes a number of antiquated shafts sunk in the late eighties and early nineties, which are useless, or practically useless, for purposes of modern ore hoisting, but are of value in securing ventilation.

What the Groups have Done.

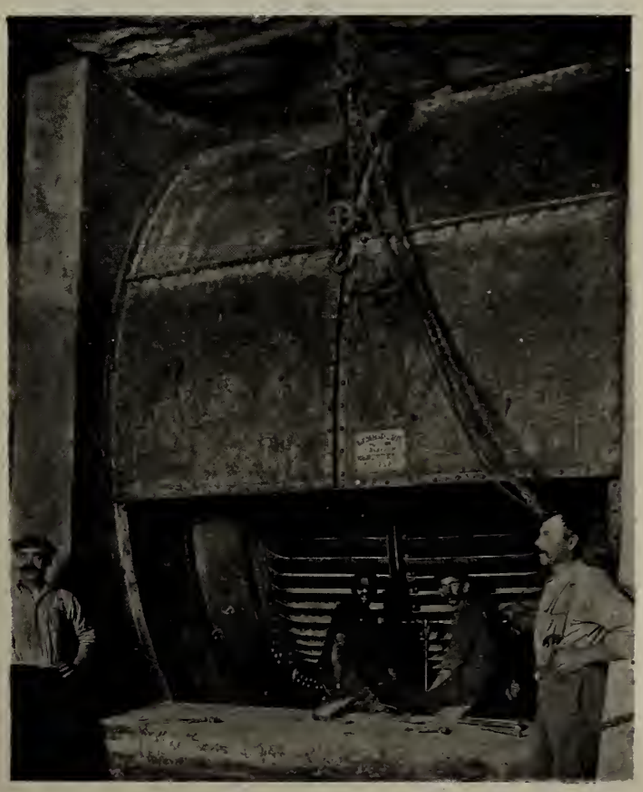
It is unquestioned that right along the reef ventilation has been greatly improved during the past year or two, and the general conditions under which underground workers labour have been substantially bettered. Sprays have been universally adopted, much more attention has been accorded to the study of air currents and "bratticing," and fans have been adopted right along the Reef. A few facts and figures regarding the larger ventilating appliances in use on Rand mines to-day should prove of much interest. There are eleven large fans in use in the mines of the Central Mining and Administration group, eight being of Sirocco type and three of the Rateau pattern. A ventilation scheme for the Geldenhuis Deep is now being gone thoroughly into, and it is probable that another fan will be erected at this mine very shortly. The following interesting table sets forth the make, sizes, and capacities of the fans in mines under Corner House control:—

Mine.	No. of Fans.	Make of Fans.	Diameter. Inches.	Capacity Cub. ft. of Air per Minute.
City Deep	One	Rateau	97½	75,000
City and Suburban...	One	Sirocco	77	88-100,000
Crown Mines ...	One	Sirocco	105	250,000
Durban Rood. Deep .	One	Sirocco	45	50,000
Ferreira Deep ...	One	Sirocco	40	30,000
Nourse Mines ...	Two	Rateau	100	75,000
Do.		Sirocco	77	100,000
Robinson	One	Sirocco	63	75,000
Rose Deep	Two	Rateau	88	80,000
Do.		Sirocco	35	25,000
Village Deep ...	One	Sirocco	126	288,000

The Ferreira Deep fan, it should be noted, is only partly erected. The volume per minute stated for the Village Deep Sirocco is the present capacity of the fan. This installation ventilates the Village Main Reef as well as the Village Deep, with its Turf Mines deep-level section. In the mines of the Consolidated Gold Fields group two large fans are working, one at the Robinson Deep and one at the Simmer Deep, whilst another large fan is in course of installation at the Jupiter. The Knights Deep-Simmer East properties are about the best ventilated mines of the group, and artificial ventilating appliances are not needed there. In addition to the large fans, the Gold Fields mines are equipped with a number of smaller appliances for improving the volume and quality of underground air. On the East Rand Proprietary Mines two large ventilating appliances are employed. In the Angelo a Sirocco fan has been installed, and a Barclay fan is at work in the Cason. Two other small portable fans for local ventilation have been put in in the East Rand workings, and it is proposed to employ others. In the Goerz mines no large fans are installed, but recently two of the three small machines have been employed in isolated places where the air was not good in the Geduld and Princess Estate. In the Barnato mines a fan has been installed at the New Rietfontein, and the installation of another to ventilate the workings from the deep incline shaft being sunk in the Witwatersrand mine is receiving the consideration of the Johannesburg Consolidated Investment Company's engineering department. The Neumann group management is installing a large Sirocco fan at the east shaft of the Knight Central mine. As a matter of fact, the ventilation here leaves little to be desired, and the fan installation is more in the nature of a safeguard than anything else. It is not probable that the fan will be in constant employment, but will be utilised as occasion requires. The General Mining and Finance Corporation are also quite alive to the advantages of efficient ventilation. In the Cinderella Consolidated a large Capell fan is employed, and two Stine fans are installed, one at the bottom of the vertical shaft and one at three thousand feet.

Wanted: A Better Response.

The foregoing should be sufficient to demonstrate that the Rand is fully alive to the benefits of securing good ventilation—not that the Rand, as a whole, has ever had really bad conditions in this regard. Ventilating fans, as recently-issued balance sheets have shown, are costly appliances to instal, but the controllers of the industry are evidently not going to allow any expenditure in reason to baulk their efforts to render the underground workings as healthy as human brains, machinery, and finance can make them. It is to be regretted that the large sums of money spent by the mines in this regard have not met with an adequate response from underground workers in the shape of better labouring efficiency.



Village Deep Electric Fan 2000 feet below Surface

Mining in Swaziland

A Neglected Industry :: Tin and Gold Prospects :: History and Review

By ALLISTER M. MILLER

TWENTY-FIVE years ago Swaziland loomed large in the hierarchy of South Africa's mineralised territories; to-day, in common with a great portion of the Eastern Transvaal, its correlated neighbour, public interest and public support has cold-shouldered it into unmerited obscurity. And yet, its fifty-miles-long line of quartz and schist gold-impregnated outcrops is just as inviting, and almost as virgin, as in the days when Tom McLachlan and Walter Carter, with their home-made dolly, inaugurated milling within the shadow of Pigg's Peak; just as attractive as it appeared to James Forbes when his boxes of bushwood laid the foundations of a fortune in the creeks and gullies of the Ngwenya mountain. Like most ventures conceived and executed in a pioneering atmosphere, it contributed the experience which bought success for others elsewhere.

As far as is known, the late Mr. Tom McLachlan was, about 1881, the discoverer of gold on the Swaziland



Bird's-eye View of Portion of the Swaziland Tin, Limited, Mbabane

Drakensberg slopes. It was not, however, until 1886 that the richness of the outcrops at Pigg's Peak and Forbes, the latter found by Mr. Alick Forbes, inaugurated the brief scramble for mining properties which led, in the course of two years, to the partitioning of the 6,500 square miles of the territory into a perfect chessboard of concession areas. In those days transport from the coast cost £30 a ton, cyaniding was an unheard-of luxury, miners imported from Cornwall worked in the faces with hammer and drill, whilst timorous Kaffirs lashed; mining and milling cost twenty to twenty-five shillings per ton, and gold not caught on the plates was swept away with unappreciated, unvalued tailings, and slimed the creek-banks for miles below the batteries.

Every outcrop seemed a certain Golconda, with unknown depths, and the high-grade surface ore was expected as a matter of course to go down. Therefore, development entered not into the system—or lack of it—of mining, and the big profits from surface work were spent in elaborate machinery in anticipation of a vast expansion of the industry. One mine equipped itself with a nine-miles railway to carry ore from the outcrop to the mill; another, out of phenomenal milling results, increased its stamping power to seventy head, to be electrically driven by a most complete installation, all landed in the territory at a cost of over £20 per ton for wagon transport alone. But just when industrial greatness seemed aripening there came a frost—"a killing frost"—which, even after the lapse of a generation, has left its blight on the aspirations of the pioneers. The outcrops were only the cappings of lenticular veins which required capital to exploit them: capital found a new outlet, and has not yet returned.

The "frost" was the opening up of a great and attractive country to the north, with the subsequent construction of a railway and the natural flow of money and industrial energy along the lines of greatest convenience. Swaziland, off the main route, has been left on her side-track to simmer unnoticed, and it is now apparent that she has to wait her turn.

Geological Features.

Geologically, the country is divided longitudinally into five distinct series, schists and quartzites in the north-west, old grey granites on the eastern slopes of the highlands and in the centre of the country, sandstones in the lowlands, quartzites and shales in the south, and the amygdaloidal basalts and rhyolites of the Lebombo range on the extreme east. The Horo, Wyldsdale, Kobolondo, Pigg's Peak, Havelock, Forbes' Reef, and Forbes and Henderson properties, all large areas, in some cases covering many tens of square miles, are located in the first series, consecutively running in the order named from north to south. Work is at present being carried on at the Swaziland Coroporation's properties on the Horo and Forbes, at the Pigg's Peak Company's mine, and on the Wyldsdale and Kobolondo. These are all gold producers, with the addition of tin at Forbes. This geological series is fringed, about twelve miles east of the western Swazi frontier, by granite, and on the west extends for many miles into the Transvaal, whilst it forms northwards that highly mineralised belt which is lost in the unexplored wilds beyond Umtali.

In the grey granites, traversed in the centre, north-west, and south-east by a massive dyke of pegmatite, are the cassiterite deposits, detritis weathered from the country rock and deposited in old river course and small

ancient lake beds, such as are being worked by the Swaziland Tins, Ltd., the oldest and largest exporters of alluvial tin in the sub-continent, and, further to the south, by McCreedy's (Swaziland) Tin Company, also a regular producer. It may be mentioned that the tin on Forbes, already referred to, differs in its matrix from the tin being worked in the granites. At Forbes it is found in stockwerk veins in schist, and in an intrusive granite body which has thrust its way through the schistose country.

At an altitude of about one thousand feet above sea level, bounded on the west by the granite system and on



Reduction Plant, Forbes' Main Reef, Swaziland

the east by the Lebombo range, are the coal measures, and on one property in this tract of country, which runs the full length of the territory, with a width of about fifteen miles, there are already some two millions of tons of coal in sight. The coal is anthracitic, almost sulphur free, with a calorific power of 14.77, with 88.75 per cent. carbon, and only 4.25 per cent. of ash. As these measures lie within sixty-three miles of the Lourenço Marques wharves, and as only eighteen miles of rails remains to be linked up with the port, the prospects of a large coal-mining industry in the country are hopeful.

Production.

It is not possible to give figures of the total output of minerals from the gold, tin, and coal fields since the commencement of production in 1886. The war suspended all work, and the territory took a long time to recover in the uncertain days of the "Settlement" after the various commissions had been appointed to adjust differences between the Europeans and the natives. The following figures, however, are reliable, and are official from 1907 onward :—

Year ending March,	Gold (ozs)	Value	Tin (Tons)	Value
1904 ...	620	£2,240	—	—
1905 ...	1,970	7,580	—	—
1906 ...	2,611	10,160	—	—
1907 ...	2,491	10,582	196	£19,644
1908 ...	3,108	13,203	535	49,568
1909 ...	6,749	28,669	526	42,005
1910 ...	11,202	46,707	446	28,368
1911 ...	13,543	57,530	476	42,250
1912 ...	13,778	58,523	312	32,397

Prospects.

The resuscitation of the mining industry in the territory depends either upon the discovery of some phenomenally rich body which will be the medium of attracting fresh capital and restoring interest in local mining, or upon the ultimate and inevitable recognition of potential riches which are scattered over a known area of six hundred square miles of highly mineralised territory. This recognition must come when more popular regions have been exploited and adventurous spirits find no more scope in their present fields of operation. Unhappily, the band of pioneer gold seekers

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is small in comparison with the vast unprospected areas of South Africa, and mining, no less than agriculture, cries out for men. From the border at Oshoek, north



McCreedy's Tin, Limited, Hydraulic Plant

through the properties owned by the Forbes and Henderson Gold Mining Company, the Swaziland Corporation (Forbes' Mineral Concession), the Havelock (Henderson's Consolidated Corporation), the Pigg's Peak Gold Mining Company, the Kobolondo (Anglo-Swazi Company), Wyldsdale, and the Horo (Swaziland Corporation), a mass of quartzites forms a continuous hog-back ridge with talcose and micaceous schist contacts on the east, and shales and banded quartzites on the west. On both sides of this mountainous intrusion a regular sequence of quartz and schist outcrops, many of which have proved of great richness, occur. These have been worked mainly as open casts at odd intervals of time.



McCreedy's Tin, Limited, Sluice Boxes at Elevator

With the exception of Pigg's Peak, which is now reaping the advantage of persistent development over a long period of years, the deepest working on this line is on the Avalanche (280 feet) and Main Reef (345 feet), both on the Swaziland Corporation's property at Forbes. No serious attempt has been made to connect at depth these constantly recurring outcrops with any regular body, though, in the light of recent discoveries, the existence of a main auriferous fracture which has been the impregnating medium of the fifty miles of reef is finding favour.

On the western side of the escarpment in the slates and banded quartzite country, a line at times in the Transvaal, at others in Swaziland, similar mineralogical conditions exist, though the outcrop bodies are generally more refractory, being frequently associated with antimony or arsenic. But, save for the work on the properties named, on a few isolated mines in the Steynsdorp Valley, and on French Bob's, this expanse of territory is a terra incognita to the present-day

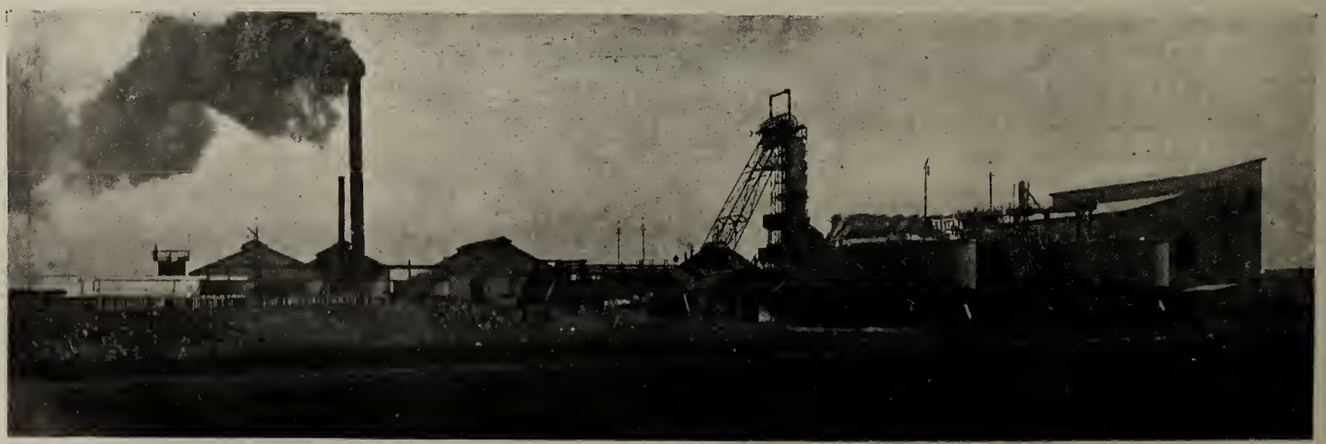


First Consignment South African Tin ready for Transport to Coast Swaziland Tin, Limited, Property, Mbabane, November, 1893

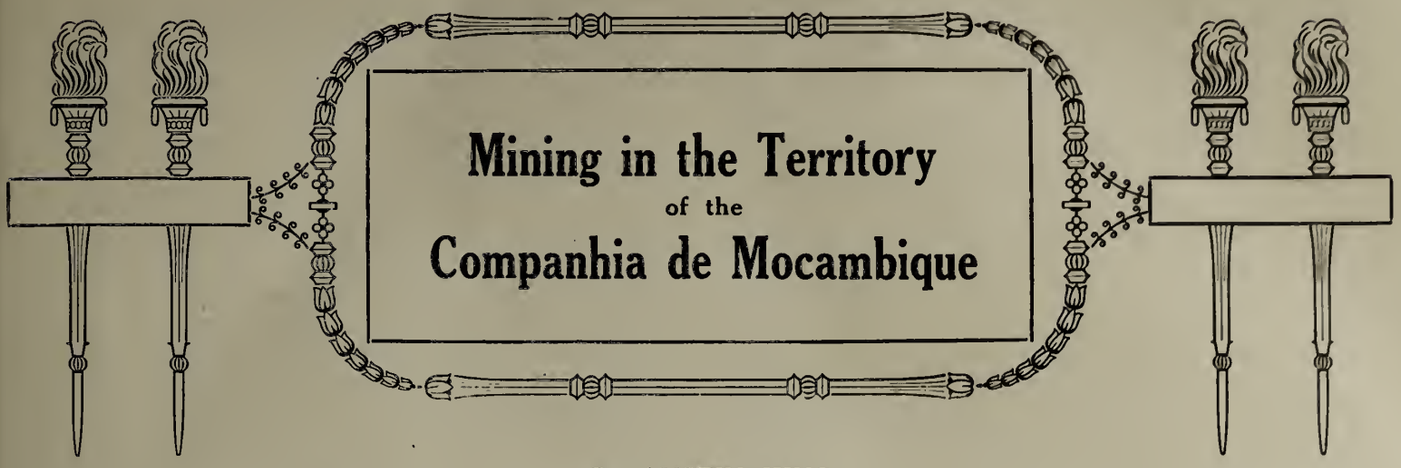
prospector and capitalist, and, it seems, must wait its turn.

Most of the Swaziland companies have, save for small reserved areas, thrown their properties open on liberal terms to prospectors, and the Swaziland Administration has provided machinery for prospecting on Government mining areas in the south and centre of Swaziland, which areas aggregate four hundred and fifty square miles. But, either through ignorance of conditions, paucity of available men, or greater attractions elsewhere, prospectors do not come, and the gold and tin mining areas of Swaziland are being subjected only to such tests as companies and individuals of long association with the country, who have an unabated faith in the ultimate establishment of a permanent mining industry, are able to bestow.

RAND MINING IN PICTURE



A Typical View on the Reef



Mining in the Territory of the Companhia de Mocambique

By AUSTIN KING
(Director of Mines, Manicaland)

IN looking over the map of Africa and noting the fields from which its great mineral wealth is derived, the eye is first drawn to the immensely rich field of the Witwatersrand and the lesser, though classic, Transvaal gold fields of Barberton, Pilgrims Rest, Lydenburg, etc.; to the wonderful diamond deposits of Kimberley and the Orange Free State Province, and to the extraordinarily widespread field, or rather collection of fields, that Rhodesia represents. Beyond these, on the extreme eastern edge of the latter territory, but forming part of none of the territories enumerated, the mining region of Macequece is marked on the maps as a gold field that lies in Portuguese territory. This field is situated within the territory of the Moçambique Company, and it may be of interst to give, in the first place, a short preliminary sketch of the constitution of this chartered company, the mineral possibilities of whose domains I propose to briefly describe in this article.

The territory of the Moçambique Company extends from the twenty-second degree of latitude south to the Luenha (also known as Ruenha) and Zambesi Rivers on the north. On the east it is bounded by the Indian Ocean, and on the west by the territories of the British South Africa Company. This large extent of country representing an area of over sixty-five thousand square miles and possessing an estimated length of something under three hundred miles of coast-line, is administered by a chartered company known as the Moçambique Company, which holds its rights from the Portuguese State under three royal decrees of 1891, 1893, and 1897 respectively. The charter is for a period of fifty years reckoned from 1891.

The Company of Moçambique enjoys a considerable degree of autonomy, being a company with sovereign rights (direitos magestaticos). Roughly, it stands on the same footing towards the Portuguese Government as the British South Africa Company does towards the British Government, and it possesses its own customs, posts, treasury, land and mining offices. The company also has its own customs tariff, land tenure and mining law. Mining rights as well as all land titles of a permanent nature (aforamento) will be recognised by the Portuguese Government on the expiry of the charter. The company's government consists of a board at Lisbon composed of a majority of Portuguese directors and of the United Committee of London and Paris, each committee having four directors who are members of the general board.

The administration of the company in Africa is carried out by a Governor, assisted by the heads of the various departments, and in each district there is a commandant, whose position may be approximately described as being analogous to that of a Civil Commissioner in Rhodesia.

The history of mining in the territory now belonging to the Moçambique Company dates back to very early times. Some persons hold Sofala to be the port of the ancient land of Ophir, from which the Queen of Sheba brought gold to King Solomon, but the numberless round shafts sunk in the valleys of the Revue and its tributaries in the neighbourhood of Macequece testify to a considerable activity, especially in the working of alluvials, at a much more recent date. The exact period to which these ancient alluvial workings, mostly consisting of shafts from eighteen to twenty-five feet deep, belong is difficult to establish. Steps cut in the sides of some of these shafts in the schistose soil are still clearly visible. The remains of an old Portuguese fort, which was apparently constructed with a view to commanding some of these workings, show embrasures for cannon which from their size would seem to indicate that the fort belongs to the earlier portion of the eighteenth century.

In addition to alluvial workings, the writer has seen an old inclined stope put down on reef that attained to a depth of some seventy feet from the surface, and has also seen an old shaft met with in reef workings of a depth of something over one hundred feet. Both had been filled in with made ground. But there is evidence to show that both reef and alluvial were worked by the ancients before the period of the Portuguese colonisation.

Colonel d'Andrade, former Director of Mines to the Company of Moçambique, afterwards Governor-General at Lourenço Marques, and actually Director of the Colonies in the Ministry of Marine and Overseas at Lisbon, quotes in his report for 1900 from the work "Eastern Ethiopia," of the monk Joao dos Santos, which proves that both alluvial and reef gold was worked in the country as far back as the fifteenth century. This interesting quotation is as follows: "The Kaffirs gather the gold either by digging out and washing in plates the earth found near the beds of the rivers and which they excavate by means of large holes or galleries with which they follow the course of certain veins with which they are acquainted, or they gather the gold by following the course of the streams where water runs in the rainy season, picking up in these the bits of gold that are exposed to view, or finally they obtain it by making use of certain stones found in the mines in which stone veins of gold occur, the separation of the gold being effected by reducing the stones to powder and washing this powder in plates. The gold thus obtained is of various kinds, in powder as fine as sand; in grains like rosary beads, large or small, in long extended pieces, some morsels so massive that they have the appearance of having been cast, others being of palm-like shape, or like branches with many twigs, others, again, being surrounded by and mixed with the soil. If this soil is separated from the gold by washing,

the bits of gold are seen to be hollow inside, like to honeycomb or like iron bars on leaving the forge, whilst the hollows and interstices are filled with red earth not as yet changed into gold, but which from its colour clearly shows that it will soon become so. The gold is usually of a high standard, except that which is obtained from the stones, which is less pure."

As Colonel Andrade points out, the description of the ancient chronicler as to the manner in which gold is met with is quite exact, and, as the late Governor-General also observes, the freeing of the gold through the decomposition of the pyrites is expressed by "the red earth which is changed into gold."

All who know the country will note how precise this monkish chronicle is, the very fine gold so often obtained in the alluvials, and especially in the reef casings, the small nuggets and heavier gold met with on the bed rock, the filigree-like pieces of crystalline gold found in 1907 in the Paradox schists, the tree-like appearance of the veins of gold, especially in the case of the float found on the Capitaine claims, all are occurrences that tally exactly with this mediæval account. As to the purity of the gold found here, the standard of the alluvial gold in the Macequece field is so high that it is worth something over £4 an ounce, whilst the bullion value of reef battery gold varies considerably and is much lower, averaging from £3 to about £3 16s. an ounce. The extent of the ancient alluvial workings in Manicaland round Macequece is considerable. Ancient workings are to be found along the Revue River scattered over a distance of some twenty-five miles. The number of old shafts is very great, scores and scores being met with quite close together in some places, whilst in others they are not so numerous. At some spots the bottoms of shafts are connected by little tunnels or galleries, and in some of these the filling in of ancient stopes is visible. The natives would seem to have carried the pay wash on their heads or backs up the little ladders cut in the sides of the shafts, and to have then washed it in earthen dishes as described by Brother Joao dos Santos. The museum of the Mines Department at Macequece possesses an old schist dish that was found in an old alluvial working that appears to have been one of the dishes used for washing gold by the Kaffirs of olden times. This old dish consists of two saucers set side by side, one large and one small, hollowed out of the schist. Iron slags have also been found at various points in Manica, and the museum of the Mines Department possesses a complete crucible embedded in these. It would seem that at one time there existed some sort of a primitive iron industry on the field that was carried on probably by a native race. Colonel d'Andrade states, in the report already alluded to, that the old natives of that time (1900) remembered the names of white workers of mines who must have belonged to an epoch dating somewhere about 1820, and that the names of these workers, gold workers, as it would seem, were Portuguese. Coming now to the early history of the modern period of mining in Manica, in 1888 the first company of Moçambique was founded and shortly afterwards sent engineers and prospectors to Manica, who discovered some reefs in the Umtali and Revue valleys. Much of the early prospecting work on the field was done in the Umtali Valley, where mining concessions were granted by the first Company of Moçambique. The original contract from which the Penhalonga Gold Mining Company derives its rights was granted by the first company of Moçambique in 1890, and some of the earliest claims marked out on the Rezende Reef were pegged under a concession originally granted by the same company; and some of the principal reefs in the Umtali Valley, viz., the Penhalonga, Rezende, Bartissol, Paiva, afterwards known as the Palmyra, were discovered and named about this period.

AN "OUTSIDE" PROPERTY OF PROMISE



Pigg's Peak Gold Mine

Later, the Vigliani Award brought about a delimitation of the frontier between the Company of Moçambique's territories and those of the Chartered Company, and thus the Umtali Valley was lost to the Moçambique Company and separated administratively from that portion of the Manicaland gold field that lies east of the watershed or divide. In 1892, a Mines Department was established by the Moçambique Company, and in the later nineties a number of claims were pegged in the Revue Valley; amongst others, those which now form the Guy Fawkes mine, often spoken of as "Pardys." In 1899, the Mines Department moved from Andrada, or old Macequece, to the present township. The mining Directorship of Colonel d'Andrade, from 1899 to 1902, was a period in which there was a considerable influx of prospectors and a considerable impulsion was given to mining work on the Macequece field. A trigonometrical survey was made, and early in 1900 Mr. A. R. Sawyer completed a geological report on the field. Geologically, the Macequece field is one with the Umtali field, but as it is now completely separated from the latter administratively, as has already been explained, the following remarks refer only to the former. As at present known, this area may be perhaps best described as being a half-circle with Macequece situated on the diameter of the circle, and with a radius extending some sixteen miles eastwards, northwards, and westwards. North and west the field reaches to the British border. Granite forms the foundation of the whole country, and with some exceptions, viz., some basic igneous and metamorphic rocks of igneous origin, the other rocks apparently rest on the granite. North and south the field is bounded by large masses of granite. Metamorphic and sedimentary rocks, generally speaking, form the gold field. Talc schist is the commonest of the metamorphic igneous rocks. Bosses of granite occur, and dolerite and diabase dykes which have often a north and south direction. Bars of ferruginous quartzites traverse the field in an approximately east and west direction, and the true lie of the reefs would seem to be parallel to these bars, whose outcrops serve as "pointers" to the prospector. The reefs are quartz; their dip, as a rule, is steep, often some seventy degrees or more; the direction of the dip is, as a rule, north or south, and there have been cases where the same reef will dip first north and then south, or vice versa. The thickness of the reefs varies considerably, and, as a rule, they are lenticular. Gold is found in the quartz reefs, as a rule, free milling, anyhow in the upper levels, but in a few instances, such as on the Agnes claims, the ore has shown itself very pyritic. Gold is found in the casing of the reef as well as in the quartz reefs themselves. Gold has also been found on the Chimezi-Rhodes Banket Claims where the reef matter consists of layers of graphitic ferruginous and talcose schists, with small pieces of quartz enclosed in banded ironstone. Gold has also been found free in the actinolite schists, sometimes in flakes with the appearance of filigree work; and finally alluvial gold is found in most of the valleys round about Macequece. Copper has also been found principally in the form of chalcopyrite at the western extremity of the field in the Serra Isitaca, where the Edmundian copper mine is situated, the Edmundian lode being a true fissure vein. Here an extensive line of country is highly mineralised with copper. A good deal of limonite occurs on the field, and iron was, as already stated, undoubtedly worked by the ancients. Amongst other minerals found are iron pyrites, galena, stibnite, blende, pyromorphite, chromate of lead or crocoisite, malachite, cuprite and azurite.

The climate of the field is, on the whole, good. It lies at an elevation of some twenty-three to thirty-five hundred feet above the sea, whilst the summits of the highest mountains attain an elevation of about five thousand feet. The dry season extends from April till about November; January and February being the wettest months. The average rainfall for the last five years in the neighbourhood of Macequece has been: 1907, 66.43 inches; 1908, 33.11 inches; 1909, 41.99 inches; 1910, 47.44 inches; 1911, 56.39 inches.

The general characteristics of the neighbourhood of Macequece are not unlike those of Barberton. The field is made up of a group of high hills and intermediate and mostly narrow valleys, in nearly every one of which runs a mountain stream which, in most cases, is permanent throughout the year. The sides of the hills are steep, and the country is thickly wooded. The abundance of water, the steep gradients, and the large quantity of timber that exists help to considerably reduce working costs by affording water power, facilities for mechanical haulage, and fuel, as well as wood for mine timbering. There are some excellent roads around Macequece that traverse the mining area in almost all directions. The average native wages paid to volunteer boys on mines are low, viz.: surface boys, 15s.; underground natives, 20s.; and underground natives who are drill and hammer boys, 30s. The Moçambique Company also undertakes at present to supply native workers on due notice being given.

The output of gold and copper during the last five years was as follows:—

	VALUE.	
	Fine Gold.	Copper.
1907	£10,881 5 7	£2,588 12 0
1908	14,549 5 0	3,495 17 8
1909	16,235 11 8	22,111 0 0
1910	26,491 17 10	20,585 12 7
1911	12,593 6 5	——

The falling off in the output in 1911 was due to a combination of circumstances of a temporary nature that adversely affected production. Financial difficulties on the part of the tributors of the Guy Fawkes mine, one of the two chief producing gold mines of the territory, caused the tributors to work the mine with an

RAND MINING IN PICTURE



Classifiers, Princess Estate

insufficiency of labour, which restricted the production of ore; and the Bragança mine, the other producing gold mine of importance, was shut down in May for development work. However, the beneficial effects of this work should before long be visible in an increased production from this latter enterprise. The Edmundian copper mine ceased production in October, 1910, and hence no copper output figures in the returns of the year 1911. The closing down of this mine, however, was only of a temporary character due to a combination of causes, amongst others, the fall in the price of copper and the desirability of making certain alterations in part of the surface plant. For this, and further development, funds were required which were found on the reconstruction of the Consolidated African Copper Trust, Limited, under the title of the South African Copper Trust, Limited. The condition of the Edmundian mine is excellent, and it has been decided to recommence development work there at an early date. During 1911, prospecting work has been begun on a large scale on the alluvial deposits of the River Revue. It is intended by the company carrying out this work to recommence operations on a still larger scale about June, as the prospecting operations were suspended during the wet season. A considerable expenditure is being incurred in the work, which has so far been carried out in a practical and thorough manner. Great importance attaches to the results of this undertaking as, owing to the extent of the alluvial deposits on the Macequece field, a point which has already been noticed in the earlier part of this article, the exploitation of these deposits, if proved payable, would constitute an important industry for the district.

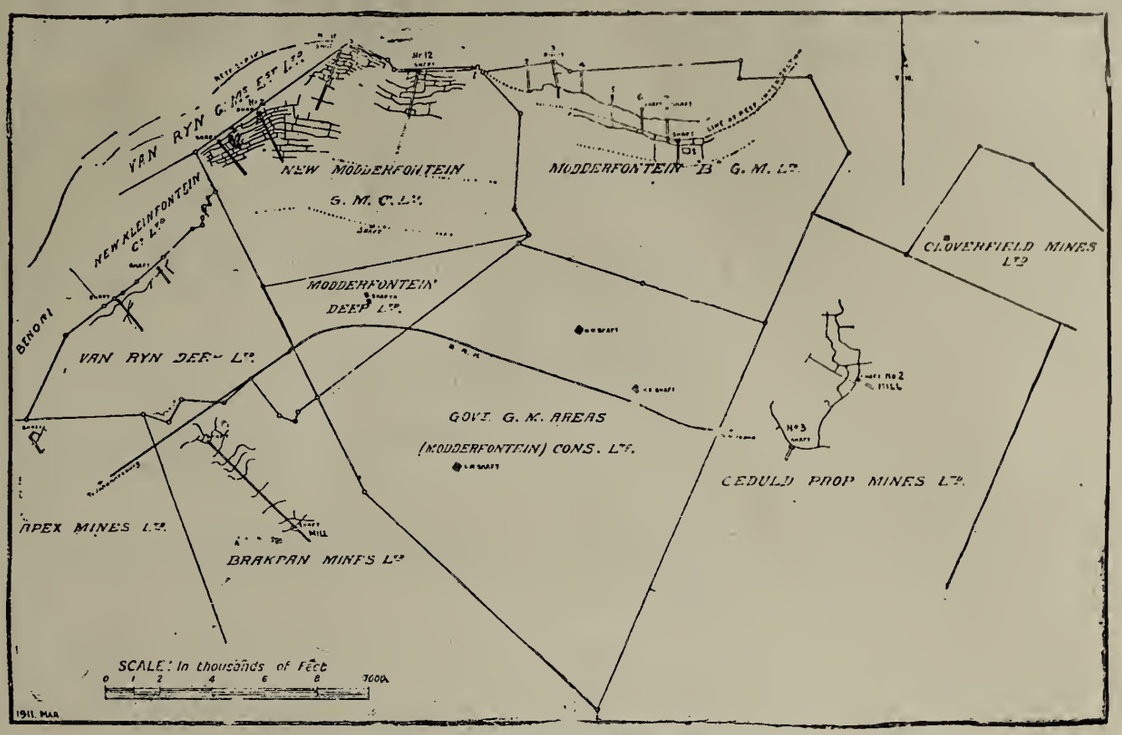
Though at present there is only one gold field in the territories of the Moçambique Company where gold is being produced, other portions of the territory are known to be mineralised. Alluvial gold has been found in Moribane and in the River Lucite, which divides that district from Mossurize. Coal and indications of copper have also been met with in the latter Province, though the commercial value of the coal discovered has not yet been ascertained. In order to facilitate prospecting and open up new and hitherto little known districts to mining enterprise, the Moçambique Company has arranged for a geological survey of its territory. The portions of the territory that are being first examined are those which it may reasonably be supposed are the most likely to be mineralised, any localities that give promise of containing minerals of commercial value being studied with especial care. Last season a large tract of the country lying along the Rhodesian border, between the Save and the Lucite Rivers, was dealt with. This season the geological expedition, which is due to leave Macequece early in June, will examine as much as possible of that portion of the country situated between the Lucite and the railway line to the north. The geological survey is being carried out under the direction of Professor Wyndham Dunstan, F.R.S., Director of the Imperial Institute in London. It seems not unlikely that coal may be found near Sena, on the south bank of the Zambesi, within the Company of Moçambique's territories. With more prospecting, and aided by the pioneer work of the geological survey that is now being made, there is good reason to believe that the territory of the Company of Moçambique may reveal further mineral resources of wealth in new districts.

RAND MINING IN PICTURE

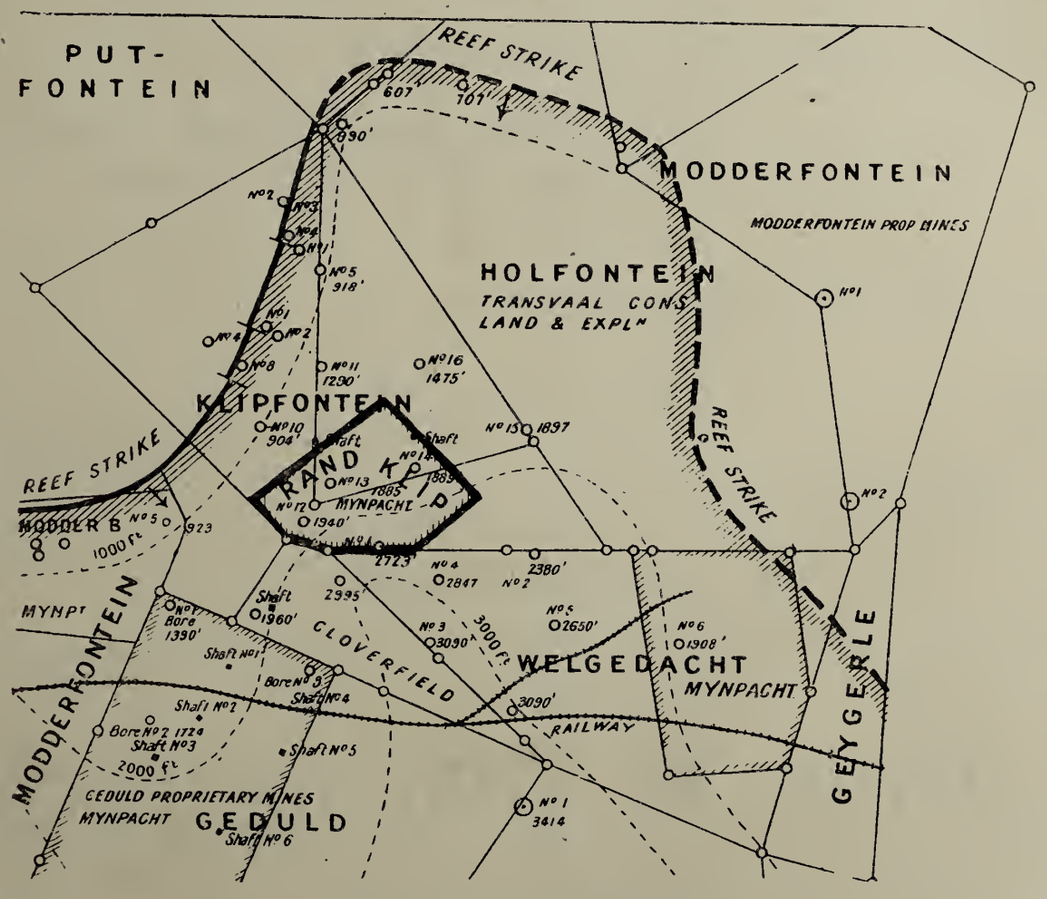


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The Position and Prospects of the Young Mining Engineer on the Rand

Some Valuable Counsel for the Mining Aspirant

By PERCY CAZALET
(Consulting Engineer, Rand Mines, Limited)

THE young technically trained men on the mines of the Rand have often a rather difficult decision to make soon after taking up work on these fields, and it is with a view to helping them to make that decision wisely and in time that I am giving my view of this subject to the "South African Mining Journal."

There is no shortage of employment to-day for the budding mining engineer on the Rand; in practice there is a pronounced shortage of efficient men, and there would be no difficulty in placing a considerable number of technically trained candidates on the mines at short notice were these available. This shortage, to my mind, is due both to the quick promotion to higher-paid work which has come in the way of the men available during the last few years, and also in a great measure as a relic of the depression which existed here for some years and which tended to scare away South African boys from taking up mining, and others, already trained in other parts of the world from coming to the Rand to seek advancement in their profession.

As a consequence of this shortage, it has become a habit for our young technically trained men to seek that work, and to follow that alone, which appears to promise the quickest promotion and the largest pay possible. This line of quickest promotion is through the sampling department to survey work; thence to the position of shift boss, and so in some cases, by easy and quick stages, successively to that of mine captain, underground manager, and manager.

Now, anyone who only follows those sections of underground work which cover the technical and administrative sides, neglecting the more laborious and less pleasant avocations which entail early hours and hard personal manual labour, may be able to gain quick promotion, but cannot at the end of a few years be either such a useful individual to his employer in the more responsible positions or such an experienced and able member of his profession as he who has carefully, systematically, and with much self-denial, grounded himself by actual experience in all the rudiments and various branches of mining.

This is undoubtedly so as regards underground work, but it is even more a fact that the man who has not also grounded himself by experience in those other branches of work which go to make up mining, namely, the mechanical, metallurgical, and clerical branches, can never as efficiently administer and control these departments when he comes to hold the position of manager of a mine, and young mining engineers who neglect these branches of their work in their youth will have no one but themselves and their confreres to blame if, when they come to take rank as managers, they are found incapable of generally supervising all branches of work on the mines, and they find that these departments are removed more and more from their control and are supervised by experts who may hold positions independent of the mine manager.

The remedy lies first in the direction of facing squarely what a technical training in mining does and does not teach one. To my mind, the young mining engineer who feels that as soon as he has gained his diploma and graduated from his college or school he is thereby qualified to take up any position up to the highest on a mine, is doing his future career the gravest injustice possible. The correct view to take of a technical training in mining (and more so in mining, I think, than in any other career) is that one has thereby been given the opportunity to study and reach the inwardness of mining problems and difficulties as they arise in one's true mining training, which only really begins when one leaves the mining school. Mining can only really be learned by personally doing the work in the company of men who have become experts at it after long years of practice and experience, and not by watching and supervising natives do it badly, as so often happens on the Rand.

If the young mining school man would look upon the knowledge possessed by every experienced miner with whom he comes in contact as a well of information and a book of mining lore, which can only be acquired by him by constant application on his part, and which is worth all the application and hard work that is in the student, we would hear less of the inexperienced shift boss and of indifferent mining methods, both of which are far too common to-day.

If I were asked to advise a young mining engineer fresh from his technical training as to what sequence of work would best fit him for promotion to the highest ranks of his profession locally, I would advise his first starting as a learner in the sampling office, as in this position he would have the greatest opportunity of learning from the experience of his seniors in this department as to the peculiarities of the gold-bearing beds and of getting training for his eye, which would be invaluable to him in his after work.

His next step should be to take up actual underground work in a junior position, preferably as assistant to a good hand stoper. If his technical training had been received at a mining school where regular underground work through the three or four years' course was insisted on, he should be fitted within a few months



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to take charge of a stope himself. This would give him the opportunity of becoming acquainted early with the science of handling natives, and would give him the necessary chance of learning to converse freely in the peculiar dialect which is used underground almost universally by natives after they have been but a short time on these fields, and which is spoken so execrably and understood so little by most of our underground workers.

After a time, the daily round of underground work might have begun to pall somewhat and energy and health to flag owing to the unaccustomed life, and a spell might well be taken as learner in the reduction works, thereby allowing of the enjoyment of more fresh air and sunshine for a time. And here let me make a digression. This change of work would mean a set-back in wages, probably from, say, fifteen shillings or sixteen shillings and eight pence per shift back to a salary of only ten pounds per month. No man likes such a reduction of pay; but, equally, no man who is unwilling to make such a sacrifice of pay for the sake of qualifying fully in his profession can expect to get the opportunity to do so, and the preparedness to make the sacrifice will in itself prove the grit that is in the student and will not go unnoticed by his superiors.

Another thing that will be involved by this decision to take an Irishman's rise is the necessity for an interview with that rather terrifying person, the "manager." Now, managers are as human as other less exalted personages, and don't like unnecessary interruptions by juniors when exceptionally busy, so I should advise steering clear of the first few days of the month, when outputs are in the melting pot and cheques and returns for signature litter the manager's desk wrist deep. Rather he should write a short note stating his wish and asking for an interview, and if the manager be worth his salt (and the majority are most sympathetic) he will make a point of seeing the applicant early after getting information from the latter's chief as to the quality of his work. If he is not, and refuses an interview, the sooner a change of mine is made the better, for the want of savour in the manager will be equally evident amongst his staff as well, and it is these men who have it in their power to inspire the student in his profession and help the seeker after information more than any books, useful as these will be as an adjunct to learning.

The length of spell in the reduction works must be a matter of individual judgment, but it should not be too short to allow of a proper appreciation of the reasons governing the operations, or too long to make underground work and hours appear a hardship when resumed; say from three to twelve months according to circumstances.

A return to underground work proper should then follow, with or without another spell in the sampling office, this time with a round of his own and a proper sense of the importance of his own slice of the work of the mine. In the position of sampler, a man has a great opportunity of influencing keenness amongst the miners he comes in contact with by following the pay leaders and discussing bedding planes with them, and the possibility of bringing down the stoping width by getting into or under some particular bed. No man, if handled right, and miners are no exception, likes someone else knowing more of his particular working place than himself, and next time the sampler comes through the stope it will be the miner who will be pointing out the true foot leader or the bastard in the hanging which he has managed to keep up, and the sampler will find himself being questioned as to values. When this happens, our sampler will know that he has not lived in vain, and that one man at least will be taking more interest in his work than before they met.

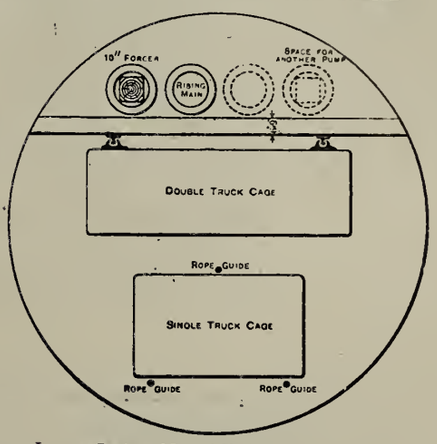
While underground for this spell, opportunity should be taken of seeing all and doing all in the various branches of mining, such as machine stoping, development, tramming, pumping, etc., rather than getting into a groove by, say, returning to hand stoping. The shift boss and mine captain should be made interested in the interest the student takes in his work, and many stray bits of information invaluable to him in after years will come his way, and he will get the chance of assisting at a breakdown or the re-timbering of a portion of the shaft, or what not, all of which will be so much grist to his mill of accumulating knowledge.

After this spell of underground work, another run through the reduction works to see those portions which he was unable to get to before would not come amiss, and if a chance occurs of acting as mine captain's, engineer's, or survey office clerk for a few months so as to get an insight into the statistical side of the work, he would never regret the time.

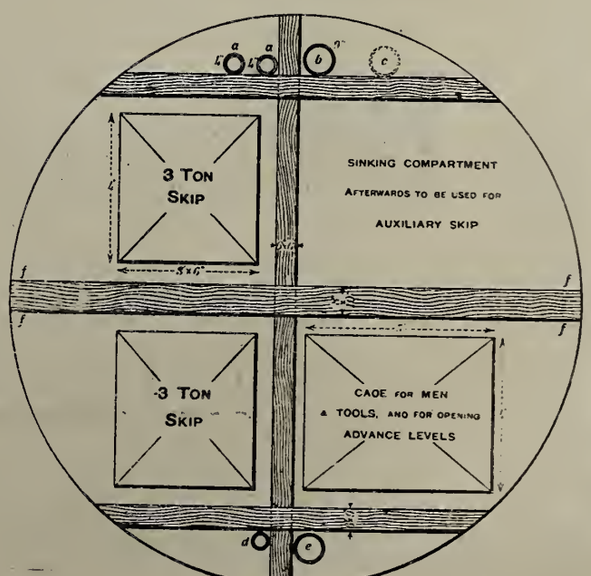
By this time the student will have spent several years of real graft at grounding himself, and the slightly less thoughtful amongst his acquaintances will be shaking their heads over him and saying that he will never get on as he does not stay long enough at any one job to get promotion, while those who know the man, and whose opinion counts, will be watching him carefully to see whether the early impressions of capacity and keenness which he gave them are fructifying, and will be giving an occasional word of encouragement and advice when he feels he wants these most.

He can now safely change his scheme of work and launch out in the direction in which he thinks he will get on best, either back to the sampling department

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en route for the survey office and a head surveyorship within two or three years, or down below again, determined to qualify for the position of shift boss as thoroughly as he is able, but in this latter case he should first spend some considerable time in the survey office to qualify thoroughly for being able to carry the whole of the mine or section of mine in his mind's eye and to know all its peculiarities and faults, as until he is able to do this he cannot do justice to the work of supervising that of others. And here I would like to say that throughout his time on the mine he should have spent odd hours on the mine plan with the head sampler, surveyor, or mine captain, talking over, and having pointed out to him on the plan, the points he may have noted underground. The study of mine development and mine valuation also is most valuable and can scarcely be overdone.

If during any of the first few years on the Rand our man has the chance of getting on to a small up-country mine, say in the Northern Transvaal or Rhodesia, he will lose nothing by taking it, since one can see so many more sides of mining in a given time on a small place than on a big one, but if he means to get on on the Rand he cannot leave this until too late or stop away too long, and must remember that the moving about which is sound during the early years of training cannot be continued too long, or it may degenerate into a tendency to become the rolling stone of the proverb.

And now a few words about reading and the gaining of necessary Government certificates.

Sport at week-ends and during summer evenings is an absolute necessity to health and clean living, and is to be encouraged, and especially so for those who spend a large proportion of their time underground; only, as with all good things, it can be overdone. A proper enjoyment of sport, however, should not interfere with or entirely preclude reading, and the student should continue his reading and attend the night classes available along the Reef in those subjects in which he finds he requires assistance. He will find the transactions of the local technical societies most useful reading, and also technical periodicals dealing with mining matters all over the world.

There are certain certificates all technically trained men should obtain, if only as an incentive to encourage the reading up of shaky subjects before going in for the qualifying examinations; these are those for surveyors, mine overseers, and mine managers.

Men must, however, recognise that the manager's certificate does not certify that the Government is satisfied the possessor is qualified to manage the mine he happens to be working on, or any other in South Africa, but is only a guarantee that if he be offered such an appointment the Government will not interfere on the score of the man's inexperience; if this point is recognised, a great deal of unnecessary heartburning will be prevented and possessors of these certificates will be less inclined to rest on their oars and cease their studies and their accumulation of knowledge.

One more final word of advice and I have done. No mining engineer who is worth his position, or a better one, knows everything about his profession, and the best of them are learning every day of their professional lives and are not too proud to learn from any miner, however humble his position in the scale of a mine's economy; and if this is so with the seniors, there is every reason for the young men coming on to follow in their footsteps and be ready and anxious to absorb knowledge from all qualified by experience to impart it, in place of putting up the backs of those very men who could help them by an exhibition of supposed superiority and cocksuredness. Fortunately, this last piece of advice is only necessary to a very small proportion of our young mining engineers on the Rand.

The procedure I have outlined above, modified, of course, to suit varying circumstances, is perhaps a trifle idealistic, and it may not always suit the economy of the mine to agree to it for all young technically trained men on that property, but it is an ideal after which each young mining engineer who is anxious to qualify himself fully should strive, and if he is in earnest he will find means to accomplish his wish, if not on one mine, then on another. If this scheme were carried out even in only fifty per cent. of the cases concerned, the results in a few years' time would be worth all the trouble managers and students alike had been put to.

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A New Method of Handling Ore in Incline Shafts of Flat Dip

By E. J. WAY, M.I.C.E., M.I.M.M., F.I.C.
(Consulting Engineer to the Anglo-French Group of Mines)

THE scheme adopted for the opening up of the Apex Mines, Limited (gold section), consists briefly of the sinking of two vertical seven-compartment shafts and the connection of these two shafts by a main incline shaft. The north vertical shaft, sunk at the rise boundary of the property, intersected the reef series at a depth of one thousand seven hundred and thirty-three feet, whilst the south vertical shaft, which is situated to the dip of the north shaft, will, it is estimated, intersect the reef series at a depth of some three thousand two hundred feet. The main incline shaft, connecting these two vertical shafts, will, when completed, be some six thousand feet in length, and, if extended to the dip boundary of the property, will have a total length of some fourteen thousand feet.

At an early stage in the development of the mine the question of the equipment of the main incline shaft had to be faced, and as the flat dip of this shaft, which is being sunk at an inclination of eleven degrees thirty minutes, renders fast hoisting by the ordinary method of winding engines and skips practically impossible, other methods of dealing with large tonnages for which the mine is being laid out had to be considered.

The almost universal adoption, in the reduction plants on these fields, of the belt-conveyor system of handling rock, sands, etc., which has followed the introduction by the New Kleinfontein Company in the year 1903 of this method of conveying ore on the surface, and the large reduction, not only in conveying charges, but also in the number of natives employed in the transport of rock, which has resulted from the adoption of this method, suggested the possibility of a belt-conveyor system being the best method of handling the large tonnage of ore which would ultimately have to be dealt with in the main incline shaft.

In order to enable a decision to be come to on this question, careful estimates were got out, both of the capital cost and of the mining and maintenance costs of the various possible methods of dealing with the large tonnage, which would have to be handled in the main incline shaft when milling, say, on the basis of sixty thousand tons per month; and at the same time special consideration was given to the questions of

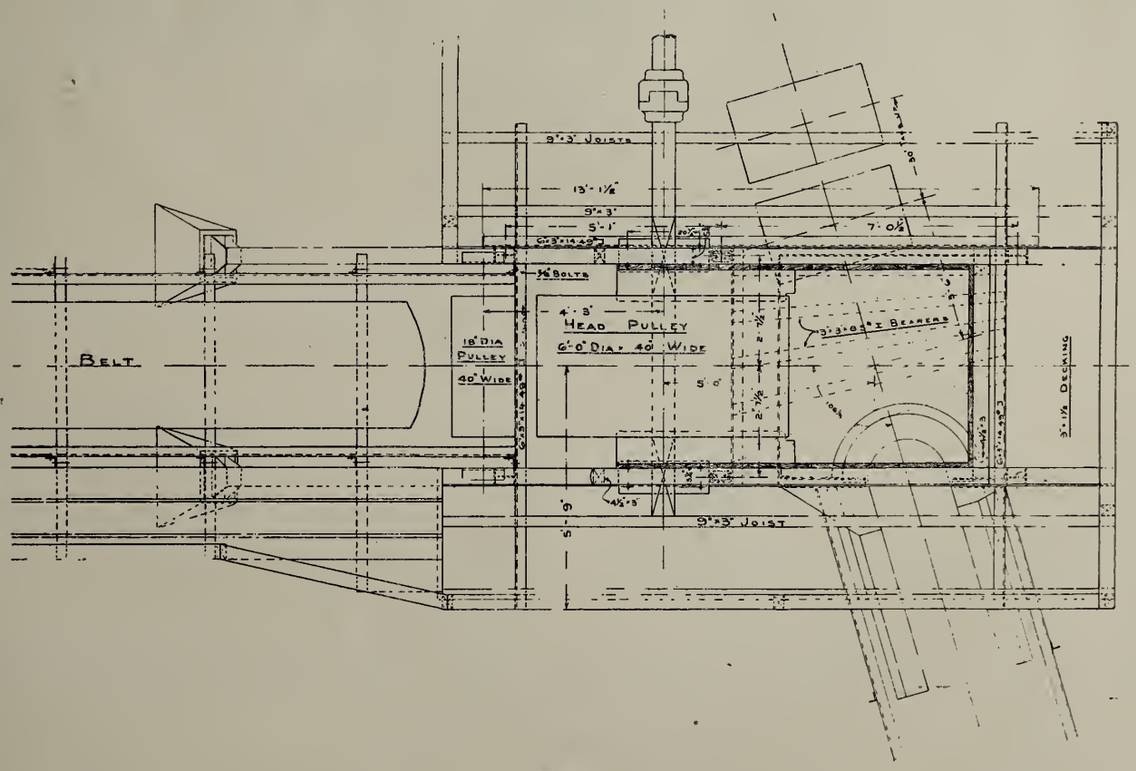


Fig. 1.

Plan of Head End of Conveyor System showing Tail End of Cross Belt to Vertical Shaft Bins.

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capacity, flexibility, and freedom from stoppages owing to breakdowns. After a careful consideration of the various methods of conveying rock the choice ultimately lay between endless-rope haulage and belt conveyors. Of the endless-rope haulage systems the over-rope system was not, owing to the dip of the incline shaft, considered suitable, and the correctness of this decision has since been confirmed by actual experience on these fields, as it has been found that, in the case of a mine where the dip of the shaft steepens from six to eleven degrees, the trucks have to be detached from the rope haulage and pulled up to the vertical shaft stations by means of a small hoist erected for that purpose.

The only other system of endless-rope haulage that appeared suitable for handling the required tonnage over an incline of eleven degrees thirty minutes was that known as the under-rope system, and the decision therefore now lay between this type of haulage and a belt-conveyor system.

Leaving out, for the moment, the question both of capital expenditure and of running and maintenance costs, it was obvious that a conveyor-belt system possessed many advantages over an endless-rope haulage system, for instance:—

(1) A breakdown in any one of a chain of belts stops only the belts below the one affected, and not those above it, whereas an accident on a rope haulage stops the whole haulage plane.

(2) A breakdown in a rope haulage stops all tramming operations on the various levels, whereas a stoppage on a belt-conveyor system does not necessarily stop tramming operations, owing to the presence of shaft storage bins at each level, which are an essential part of a belt conveyor system.

(3) The liability of a serious breakdown involving a long stoppage is practically avoided. In actual conveyor-belt practice it is found that practically any breakdown can be put right in a few hours, whereas a bad smash-up on a rope haulage on an incline of eleven degrees thirty minutes might easily cause a delay of days.

(4) When hoisting from the top levels, only power for the top belts is necessary, whereas in any system of endless-rope haulage the whole haulage plane must be operated.

(5) There is no practical limit to the extension of a belt-conveyor system, as the ore from even the southernmost corner of the Apex property, some fourteen thousand feet from the north shaft, could be handled as easily as the ore from the upper levels of the mine.

As these advantages were admitted, even by the opponents of the belt-conveyor system, it only remained to decide whether the capital cost of a belt-conveyor system was prohibitive, and in deciding this point due weight had, of course, to be given to the relative running and maintenance costs of the two systems.

It was estimated that the cost of the installation of the belt-conveyor system would average £7 per foot for material and erection; as a matter of fact, for the three thousand feet erected to date, material has cost some £5 15s. per foot and erection approximately £1 per foot, or a total actual cost of £6 15s. per foot. In addition to the cost of the belt installation, the cost of the storage bins at each level had also to be considered. These bins have a capacity of one hundred and fifty tons, and were estimated to cost £500 each, or an additional £1 per foot of belt conveyor installed in the main incline shaft. This estimate of the cost of the bins has proved practically correct, so that the total estimated cost of the belt installation amounted to £8 per foot, whilst the actual cost has been £7 15s. per foot.

An estimate of the cost of an under-rope haulage system, designed to deal with the required tonnage, worked out at approximately £2 5s. per foot, the cost being comparatively high owing to the steepness of the incline necessitating the haulage being in sections of not more than one thousand five hundred feet in length. From the estimates, therefore, it appeared that the installation of a belt-conveyor system would cost

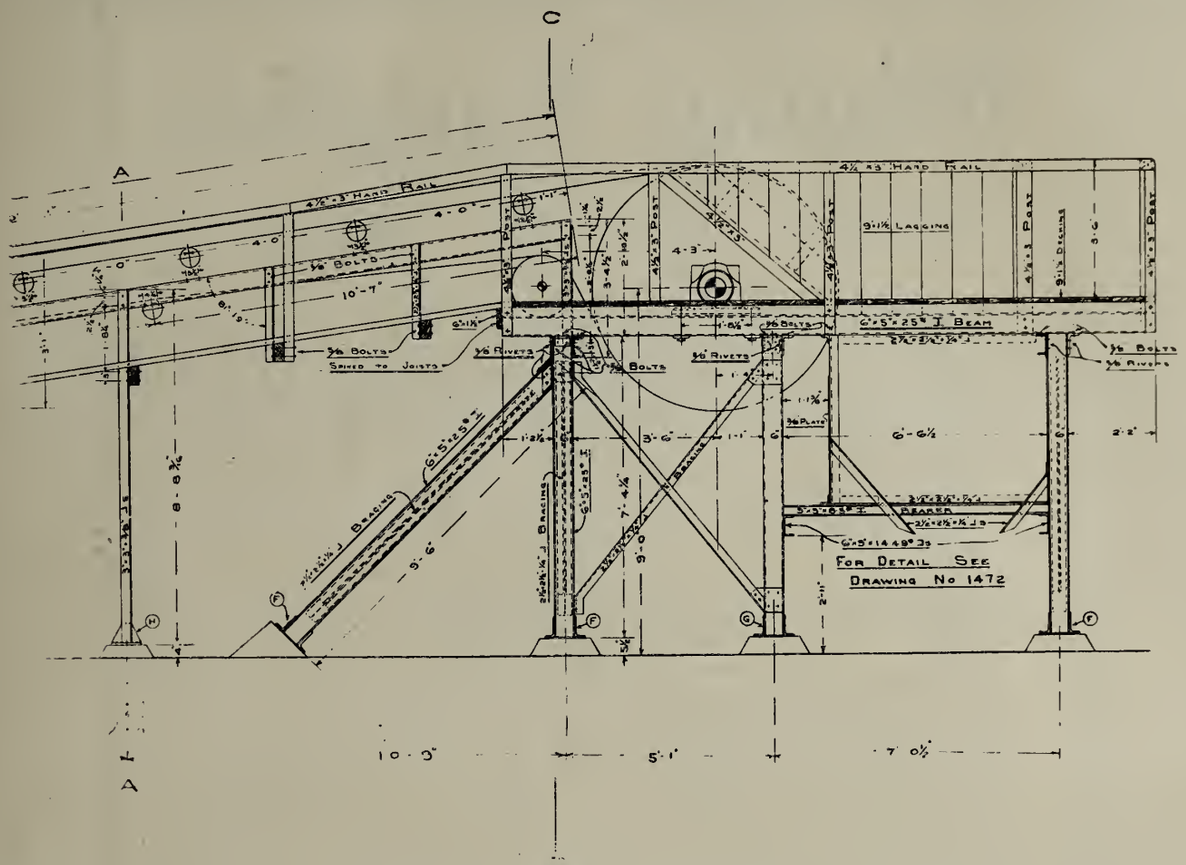


Fig. 2.

Side Elevation of Head End of Conveyor System.

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some £5 10s. per foot more than the installation of an equivalent under-rope haulage. This, on the six thousand feet incline between the two shafts, amounted to an excess capital expenditure of £33,000.

The question of the running and maintenance costs had next to be considered. In arriving at these costs the comparative capacity of the belt-conveyor and rope haulage systems was estimated to be four hundred and two hundred tons per hour respectively. Taking the tonnage mined, therefore, to be eighty thousand tons per month, all the rock broken could be handled by means of the belt-conveyor system in one shift of eight hours per day, whereas with the rope haulage system it would require two shifts of eight hours each per day to handle the same tonnage.

After going into the question very carefully, it was estimated, in the light of a long experience with surface belts, that three white men and twenty-seven boys per shift should suffice to run six thousand feet of belt-conveyor system satisfactorily; whereas, with the rope haulage, it was estimated that at least five white men and one hundred and thirty natives per shift would be required to work a similar length of the main incline shaft. The power costs, it was estimated, would be very nearly the same, but probably slightly in favour of the belt system.

In view of this fact and of the many other advantages already detailed in favour of the installation of a belt-conveyor system, it was finally decided to adopt this system for the purpose of handling the ore passing through the main incline shaft.

A conveyor-belt system has, of course, to be in sections, and the question therefore arose as to what would be the best length to adopt for the sections of the conveyor. This was a question of some difficulty as, whilst it was important from the economic standpoint, both with regard to capital expenditure and running and maintenance costs, to keep the number of sections as few as possible, it had at the same time to be borne in mind that a long length of belt fully loaded with rock would not only require a considerable expenditure of power, and therefore necessitate a large motor to drive it, but would also be apt to slip on the driving pulleys unless the belt was tightened excessively, which would result in an increase above the normal of the power required to drive the belt and also in stretching, and so weakening the belt. Fortunately, experience gained in designing belt-conveyor installations for the surface handling of rock had resulted in the accumulation of valuable data bearing on this point, and a careful survey of the subject resulted in a decision to adopt lengths of five hundred feet, a decision which the trials with the sections of belt already installed have proved to be fully justified.

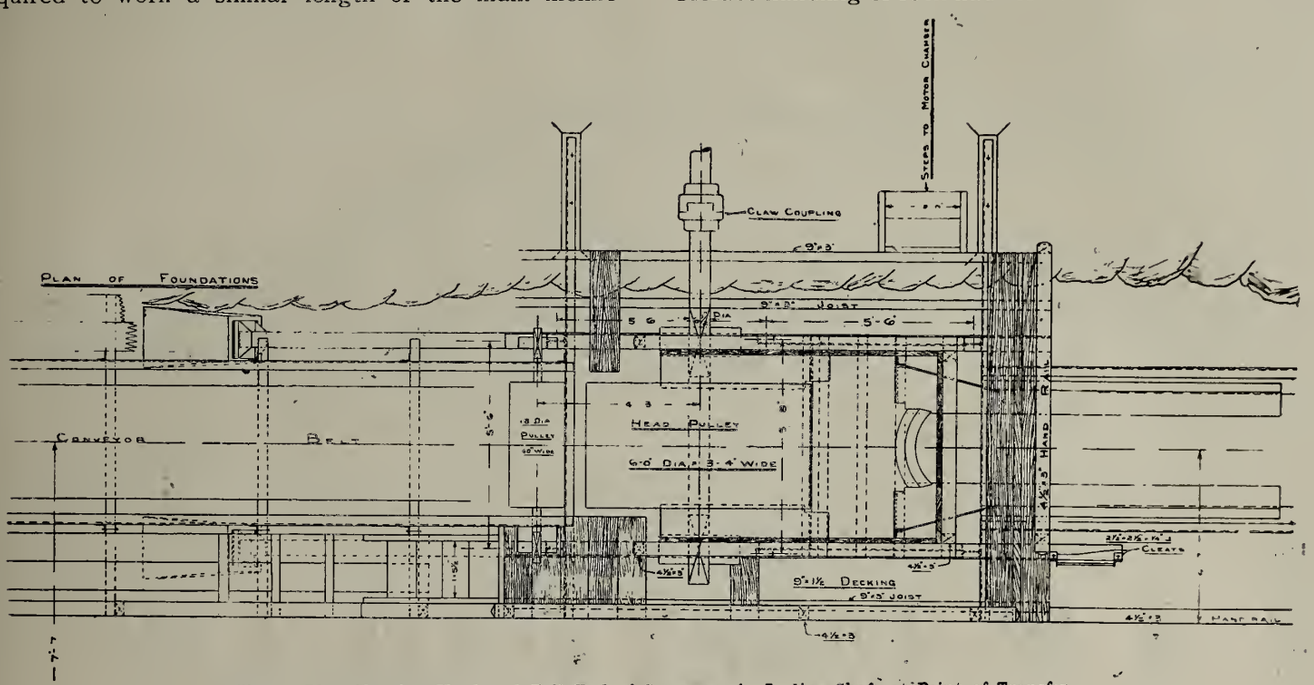


Fig. 3—Plan Showing Head and Tail End of Conveyors in Incline Shaft at Point of Transfer

There is nothing actually novel in the construction or arrangement of the belt-conveyor system installed underground, as it is practically in every particular similar to installations serving a like purpose on the surface. Briefly described, the conveyor system, as erected, consists of a series of conveyor belts thirty-six inches wide, arranged in five hundred feet lengths; each belt, which is driven through a "Baker" reduction gear by a 55 h.p. three-phase, three thousand volts, twenty-five cycles induction motor manufactured by the A.E.G. Company of South Africa, Ltd., runs at two hundred and fifty feet per minute and has an estimated capacity of four hundred tons per hour. The head and tail pulleys, troughing and return idlers, guide idlers, etc., have been supplied by Messrs. Fraser and Chalmers, Ltd., but the whole of the structural steel work in connection with the installation has been prepared in the workshops of the Kleinfontein Group Central Administration. At the present time several types of belt are being experimented with, but the belts have not been running long enough for any decision to have been come to on the question of which is the best type of belt for the special conditions met with underground.

Taking the above figures, and allowing six per cent. interest on capital expenditure, which is equal to a net increase on the belt-conveyor costs of £165 per month, the saving which it is estimated would result from the installation of a belt-conveyor instead of a rope haulage system amounts to some £1,361 per month, or £16,332 per annum. In other words, the difference in the capital expenditure in favour of a rope haulage system would be wiped off in some two or three years by the difference in the running and maintenance costs in favour of a belt-conveyor system.

The estimated total running and maintenance costs for six thousand feet of the main incline shaft worked out at £434 per month with the belt-conveyor system and £1,960 per month with the rope haulage system, which is equal to 1.302d. per ton mined for the belt-conveyor system and 5.88d. per ton mined for the rope haulage system. In connection with these estimated figures, it may be pointed out that rock can be handled by means of belt conveyors on the surface at a less cost than the above, and that on an underground rope haulage some five thousand feet in length, one of the most up-to-date installations on these fields, the actual cost per ton mined is 5.66d.

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The head end of each belt delivers on to the tail end of the belt immediately above it, the head end of the final belt in the main incline shaft delivering on to a cross belt, two hundred feet in length, which runs along the first level from the head end of the system of belts in the main incline shaft to the main bins at the bottom of the north vertical shaft. These main bins have a capacity of one thousand one hundred tons, and are divided by a vertical partition into an ore bin of a capacity of seven hundred and fifty tons and a waste rock bin of a capacity of three hundred and fifty tons. It is ultimately intended to instal a shuttle belt conveyor below the delivery end of the cross belt to enable the rock broken to be fed as required either into the ore bin or the waste rock bin.

The construction and arrangement of the belt-conveyor system will be very clearly understood if the reproductions of tracings illustrating this article are carefully studied. Of these reproductions, fig. 1 is a plan showing the head end of the top section of the conveyor in the main incline shaft and the tail end of the cross belt running to the main bins at the botom of the north vertical shaft, whilst fig. 2 is a side elevation of the same portion of the conveyor system. Figs. 3 and 4 are respectively a plan and a side elevation showing the way in which the head end of a conveyor in the main incline shaft is arranged to deliver on to the tail end of the conveyor next above it.

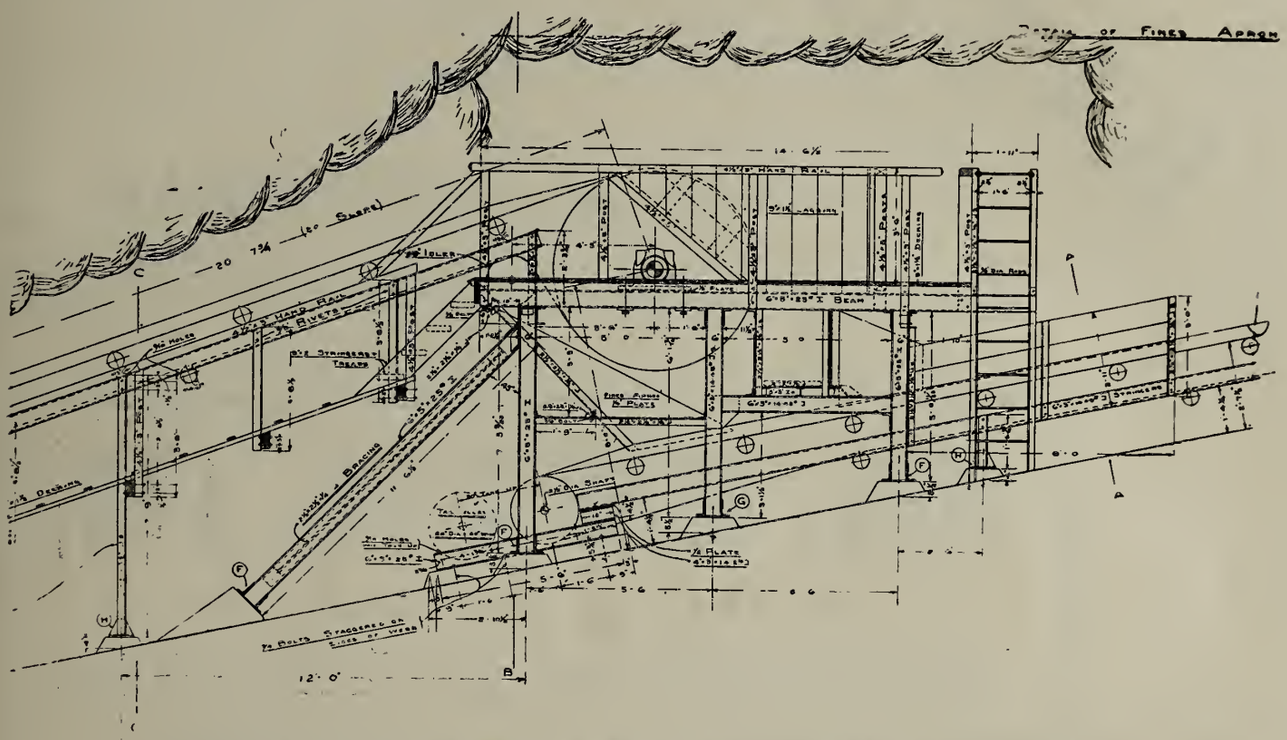


Fig. 4—Side Elevation showing Head and Tail End of Conveyors in Incline Shaft at point of transfer.

In addition to the belt-conveyor system, the main incline shaft will have a double line of track to facilitate the handling of men and tools in the incline; and arrangements have also been made, by means of a side chute in the storage bins at each level, to feed ore from the storage bins direct into trucks running on the haulage tracks, so that, in the event of a breakdown in the conveyor system, it will still be possible, to a certain extent at least, to haul ore from the levels whilst any necessary repairs are being made to the conveyor system.

In a system of belt conveyors, such as the one here briefly described and illustrated, in which each belt is driven by a separate motor, it was early recognised that a stoppage of any one belt would be a very serious matter, as, unless means were taken to ensure that such a stoppage automatically put out of action every belt below the one affected, it would result in an accumulation of rock dumped on the broken down section from the sections still running below it. Arrangements had, therefore, to be made, such that, in the event of a stoppage of any one conveyor section, all the sections situated below the one which had stopped should be automatically and immediately put out of action.

As the conveyor belts are electrically driven, this presented no great difficulty, and was, as a matter of fact, carried out quite simply, as is shown very clearly in fig. 5, a diagram giving the connections for the switch gear controlling the motors driving these belt conveyors.

As will be seen by an examination of this diagram, each motor is controlled by a main oil switch, which is provided with two overload and one no-volt trip coils, and a small auxiliary air break switch interlocked with the oil switch in such a manner that when the oil switch is open the auxiliary switch is also open. The current supply for the no-volt trip coils is obtained from a single-phase transformer placed on the feeder side of the first motor control panel. A twin cable of suitable section connects the no-volt tripping coil and auxiliary switch of each panel with the next, the connections being arranged so that in the event of any one oil switch being opened the current supply to the no-volt trips of all panels below that point is interrupted by means of the auxiliary switch, and in consequence the oil switches are automatically opened and the motors stopped, and these switches cannot again be closed in any but the correct rotation, viz., starting at the top and working downwards.

So far, three thousand feet of the main incline shaft have been equipped with the belt-conveyor system, six sections of five hundred feet length having been already installed. The installation has, to date, been a most unequivocal success, as not only has it proved fully equal to its estimated capacity of four hundred tons per hour, but the electrical arrangements for automatically stopping the belts below any section of the system, should such section be stopped from any cause whatever, have proved most satisfactory, as they have acted automatically and instantaneously.

To ensure this control apparatus being kept in proper working order, it has been the custom upon shutting down each day, after the conveyor belts have completely discharged the ore from the various ore bins, to stop the whole system of belts by tripping the first oil

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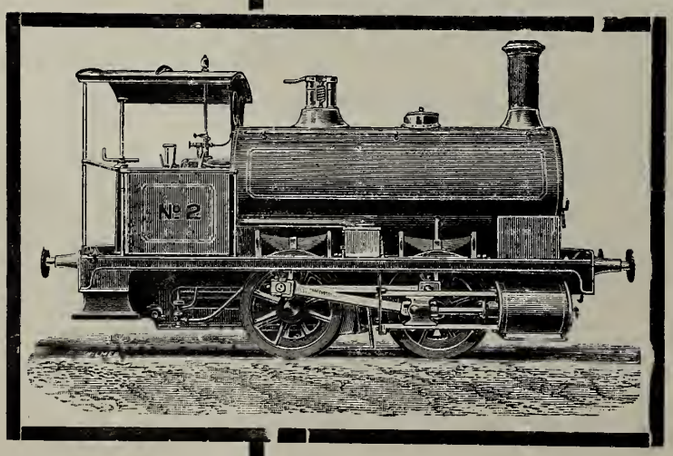
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switch in the series, and in no single instance have the automatic arrangements failed to operate.

As far as it has been possible to judge at the present time, the actual running costs should be well within the estimated figure. With regard, however, to maintenance costs, it is not yet possible to express an opinion based upon actual results underground. The estimates of these costs were based mainly upon the results of experience with conveyor installations on the surface, and it is therefore probable that, in this case also, the actual costs will be well within the estimated costs, as it must not be forgotten that, whereas on the surface the conditions are distinctly bad owing to the direct effect of the sun's rays, rapid changes of temperature, rapid changes of moisture in the atmosphere, etc.; underground, on the contrary, they are distinctly good owing to the steady temperature and moisture conditions.

It is, of course, too early yet to speak with authority; but it appears at the present time that the decision to instal a belt-conveyor system instead of a rope haulage system will be fully justified by actual results, as, from the experience so far gained in their use, there appears to be no doubt whatever that very considerable economies will result, not only in actual working costs, but also in the number of natives employed in the handling of ore underground, and of the importance of this latter point there is no need for emphasis at the present time.

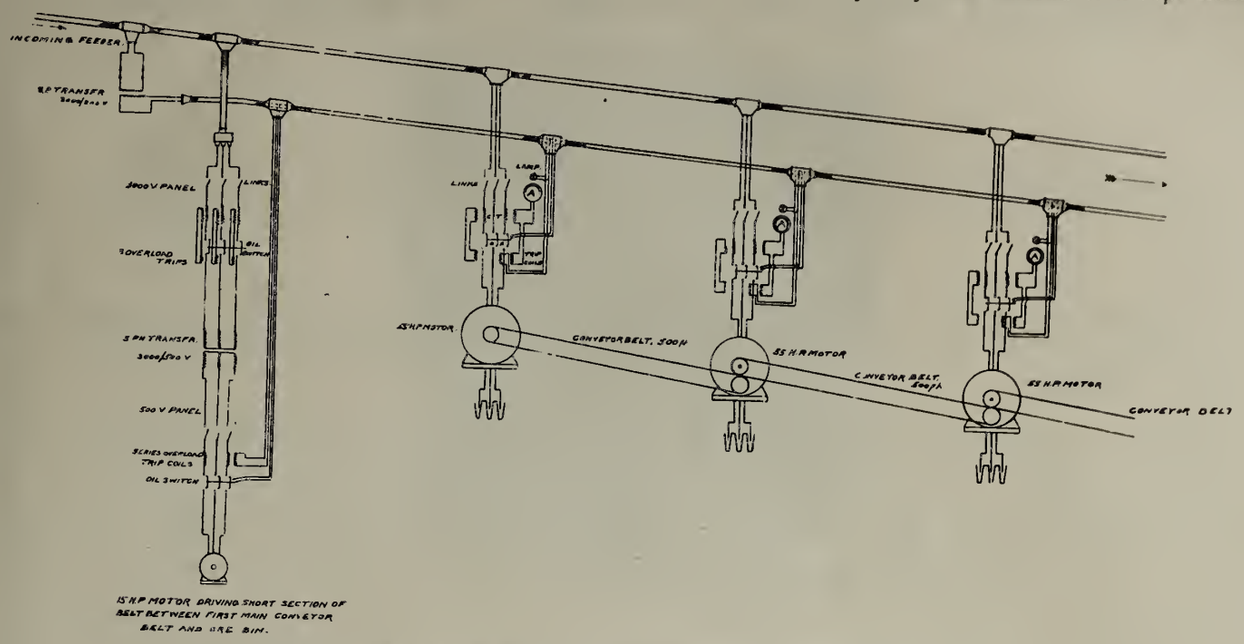


Fig. 5—Diagrams showing Connections for Switch Gear Controlling Motors

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"Such bolts and other fittings of drums, brakes, and clutches, as might be a source of danger in the event of their becoming loosened, shall be rendered secure by means of suitable locking devices."





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Solving the Loose Nut Problem

MINE engineers, in common with their tramway, railway, and motor confreres, continually meet with trouble from the vagaries of vibration. The effect of this is most marked upon screws and nuts. A great deal of ingenuity and mechanical ability has from time to time been brought to bear on the subject, and, as a result, numerous devices have been invented, by means of which the effect of vibration, so far as it affects the tightness of a nut, is more or less neutralised. These, in a very large number of cases, take the form of a washer, which holds the nut in relation to the bolt on which it is fixed, or in relation to the face on which it beds; others again are self-contained in or on the nut. The former are, no doubt, in many cases fairly satisfactory when once in position, but where a nut has to be frequently removed and replaced for making adjustments, etc., there is always the danger of the workman omitting to replace the washer, with the result that the nut is not locked and will, if subjected to vibration, slack off with results more or less disastrous, according to the particular work which the nut is required to perform.

Many of the locking devices, where they form part of the nut itself, are quite efficacious, but by reason of the nature of the device intended to do the locking, they damage the screw thread when an attempt is made to remove the bolt or stud on which the nut is placed.

An ingenious contrivance, proved beyond doubt, meets all the conditions necessary to produce a lock-nut of the highest degree of efficiency, and which is free from these objections, is the "Bevan" patent lock-nut, and it is quite self-contained and in appearance exactly similar to a standard nut. It will naturally take the place of any nut without alteration of the length of the bolt, and when screwed home automatically locks itself in position. The locking arrangement consists of the application of a well-tried principle, and on that account commends itself to the practical engineer; a short description will make this quite clear.

The actual locking device consists of a roller, grooved according to the pitch of the thread inserted into a groove cut in the nut with one of its faces tangential to the thread, upon which the roller acts when performing its function of locking the nut. It will be readily seen that when the nut is screwed "on," the roller will tend to take up a position in the groove where the depth from the face to the thread is greater than its diameter, but any tendency for the nut to move in the opposite direction immediately brings the roller into a position where the depth of the groove is less than its diameter, and consequently prevents movement of either the bolt or the nut. Tramway engineers will readily appreciate the value of such a device as that embodied in the "Bevan" lock-nut, owing to the difficulty experienced in keeping nuts fast on brake rigging, motors, motor cases, etc., where the slacking off of an important nut may place the car and its load in a position of great danger.

The "Bevan" lock-nut is made in all sizes from a quarter-inch diameter upwards, and the locking device can be fitted to any special nuts. It is also made in the form of a double-lock nut, i.e., a nut which will lock itself immediately the small key is removed from the recess in the nut, in which it is placed in order that the nut may be screwed on to its bolt. The double-lock nut is specially suitable for brake adjustment purposes, in that when once in position it cannot move in either direction under the influence of vibration, and it has the further advantage that fine adjustments can readily be made.

Either the single or double-lock nut is easily removed, as by the simple process of inserting the small key or wire nail into the groove the roller is prevented from moving into the locking position and the nut becomes, to all intents and purposes, a standard nut, and may be handled in an exactly similar manner. Recent tests with this nut have conclusively proved that it has a high factor of strength, and that it will carry loads much greater than the bolt on which it is placed.

Everyone who has had to do with machinery, even the cyclist, knows the difficulty of keeping nuts and bolts tightly screwed up, and ever since machinery came into general use inventors have been exercising their brains to find a solution to this problem, and it is therefore with exceptional interest that one examines what has proved to be a practical solution, whose claims so far have not been shaken by the severe tests to which it has been put. It is unfortunately true that devices have before appeared on the market for which similar claims were made, but which were not borne out by actual use, consequently engineers have become sceptical and will be apt to consider that this new lock nut will also be more trouble than it is worth. In this case, however, no such fear need be anticipated, as the merits of this invention have been amply demonstrated in practical use on tramway and railway rolling stock, and the engineers who have been responsible for the carrying out of exhaustive tests are unanimous in its favour.

One drawback to some previous patents for the same purpose has been that even when the nut was retained in position, when it was desired to loosen it, it was found that this could not be done without injuring the thread on the bolt, but this is impossible with the "Bevan" nut, which can be equally easily fixed or removed.

The locking device consists of a roller grooved according to the pitch of the thread, which is inserted into a groove cut into the nut, one of its faces being tangential to the thread, upon which the roller acts in locking the nut.

It is unnecessary to go into a detailed technical description of the "Bevan" nut, which anyway would probably prove inconclusive, but we may add that, in addition to the satisfaction that it has given when used on mines, tramways, railways, etc., it has been tried and not found wanting in other searching tests, such as the connecting-rod ends of reciprocating riddling machines, on rock drills, on steam hammers, on fish plates on permanent ways, and in every instance the verdict has been one of entire approval. Messrs. Power and Greatrex, 7 and 8, Bettelhim Buildings, Johannesburg, are the sole agents, and will be pleased to give any further information as to the nut.

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NEARLY a year ago the Transvaal Miners' Phthisis Sanatorium at Modderfontein was officially opened by the Administrator of the Transvaal. We reproduce here a picture of the frontage of the building. In a reference to the ceremony, a past president of the Chamber of Mines, Mr. H. O'Kelly Webber, at the meeting of the Chamber of Mines, said: "After much delay, I have the pleasure in assuring you that the Miners' Phthisis Sanatorium will be opened by the Administrator of the Transvaal. This institution is a free gift of the shareholders of the mining companies of the Rand to miners who wish to undergo treatment and recover their health, and the Government have graciously made themselves responsible for half the cost of maintenance. I regret to say that certain misapprehensions have got abroad among miners concerning the Sanatorium. These I would like to remove at once. There is no connection whatsoever between the Sanatorium and the Phthisis Compensation Fund. The doors of the Sanatorium are open to all those who wish to be treated for miners' phthisis. The Sanatorium is situated in an ideal spot; it is perfectly equipped; it has a most sympathetic medical superintendent and a full staff of nurses; and it is possible for miners who have contracted miners' phthisis to enjoy the comforts of a modern sanatorium with every chance of being cured."



Front View of Miners' Phthisis Sanatorium

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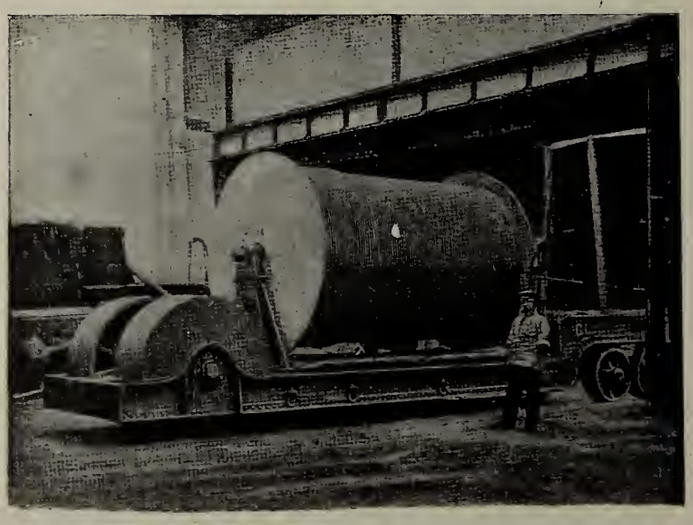
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After the failure of the large gas engine installation of the Johannesburg Municipality, which caused so much inconvenience to the public at the time, and acted as so great a set-back to this form of prime mover, it is greatly to the credit of gas engine makers that the consulting engineer to the above mine, Mr. Edward J. Way, undertook to recommend the installation of large suction gas engines for this power station.

On January 13th, 1911, the order was placed with Messrs. Sturrock and Co., mining engineers, Johannesburg, for two "Campbell" suction gas engines, each capable of developing 360 brake horse power, together with two of the "Campbell" open hearth suction gas plants. The erection of the engines was undertaken by the suppliers, who commenced last September, and on February 10th of this year the engines were successfully started up.

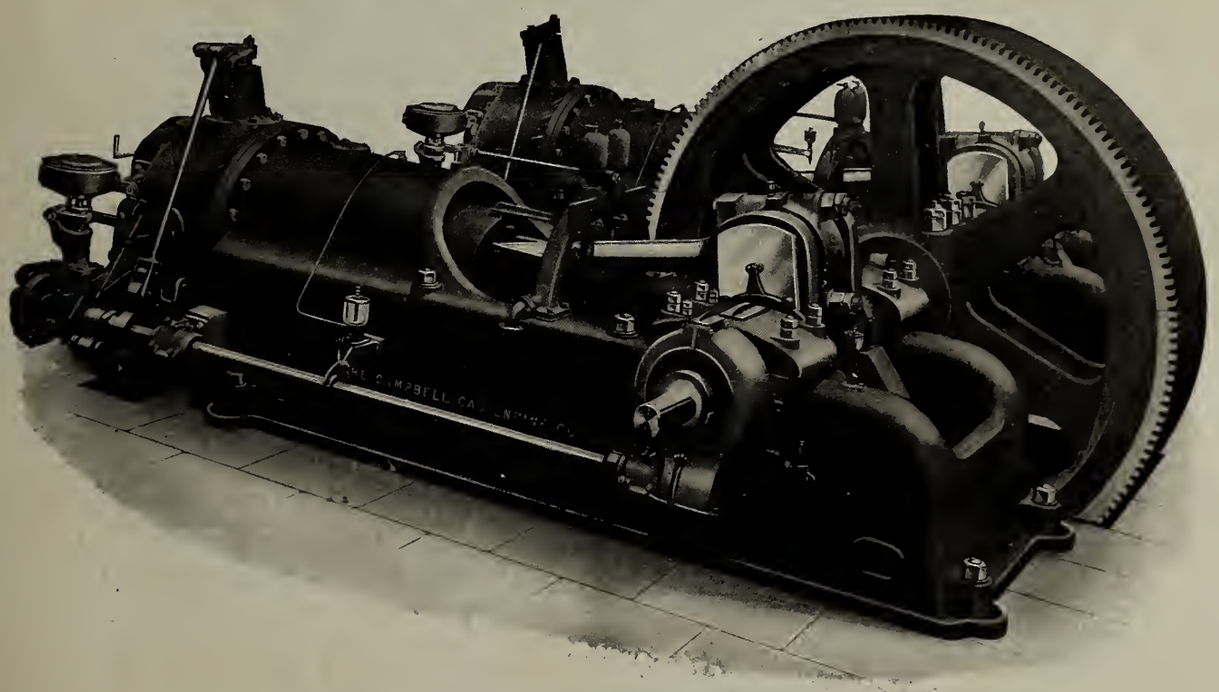


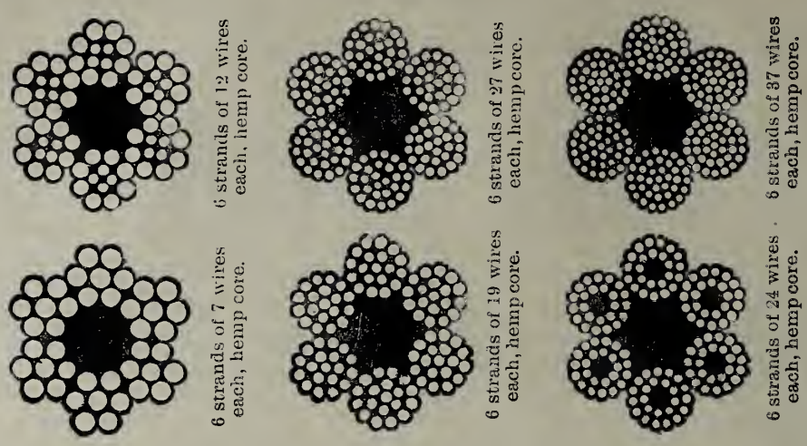
Illustration of one of the two "Campbell" 360 B.H.P. Units supplied to the Rooiberg Tin Mines

There are several features regarding the engines and producers especially worthy of note to engineers. The engines are of the horizontal twin-cylinder type, consisting practically of two single-cylinder engines with a double-throw crankshaft and one flywheel, which is cast in halves and placed between the engine beds. An engine of two single-acting cylinders has several advantages over the large single-cylinder double-acting engine. In the first place, the power is divided between two cylinders of moderate size instead of being developed in one large cylinder. A further advantage is that the engine can run with one cylinder only, if the other is dismantled for any reason, so that the entire stoppage of the engine is avoided. The engines work on the four-cycle or Otto-cycle system, the cylinders are single acting, and are so arranged that an impulse is obtained once in each revolution of the crankshaft. On referring to the illustration given below, which is an exact reproduction of one of the engines supplied, one will note the massive bedplates which extend beneath the cylinders as far back as the combustion chambers, thus supporting the cylinder along the whole working length and reducing the overhang and vibration to a minimum.

It is interesting to remark here that one of the above sets was started up to work for the first time and run up to its maximum speed with a half-crown standing vertically on end on the engine gas cock, and remained so until removed, thus showing the effect of extending the bedplate under the combustion chamber. The cylinders are fitted with removable liners, and the cylinder ends are removable and separate from both the jacket and liner. The pistons and exhaust valves are efficiently water-cooled, and the bearings for the connecting-rod gudgeon pin are formed in the piston; the gudgeon pin is shrunk into the connecting rod, thus enabling the brasses to be adjusted without withdrawing the piston from the cylinder. The crankshafts are made from Siemens Martins steel, the quality of which is that specified by the standard specification for locomotive crank axles. Large balance weights are fitted to the crankwebs, and are secured by straps of best Yorkshire iron passing round the webs, into which they are recessed, and through the weights. The governors are of the throttle type, working on the variable quality

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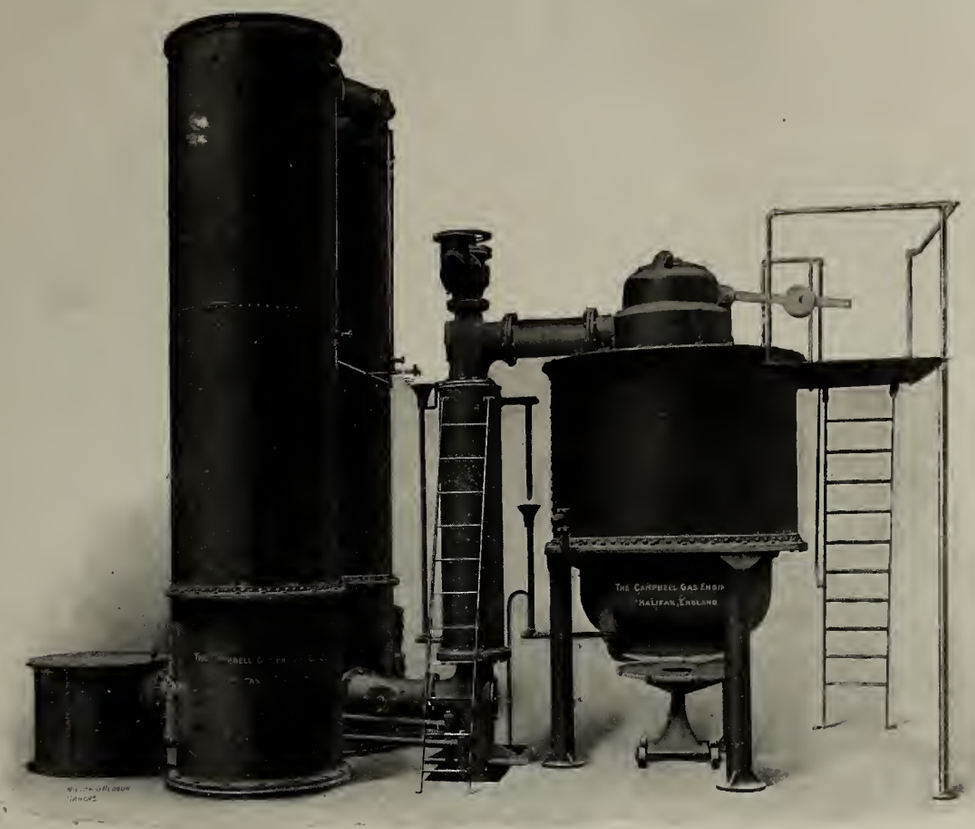
system, in which the quality of the mixture is varied, and consequently the compression, even on light loads, remains practically constant. The lubrication of the engines has been most carefully thought out; the crankshaft and camshaft-bearings are fitted with ring lubricators, and the crankpin is fitted with a positive centrifugal lubricator; the piston and cylinder are fitted with a force-pump lubricator, and the gudgeon pin by a sight feed.

With regard to the suction gas plants. They are of the "Campbell" open-hearth type, and the introduction of this type of plant marks what is probably the most conspicuous improvement that has been made in the design of suction gas plants since they came into practical use.

The fuel used in all suction gas plants up to the present has been anthracite, coal, and sometimes coke, and in some countries charcoal. The price of anthracite has increased, and the supply of charcoal is gradually giving out; this type of plant was, therefore, put upon the market by the Campbell Gas Engine Company some years ago with a view to utilising cheaper fuels, such as small anthracite of the poorest class, coke breeze from gas works, screen refuse from coke ovens, and the semi anthracites found in South Africa. In some cases the fuel bill is nil, as the material burned is a waste product, such as smoke-box char from locomotives.

This illustration is of one of the open-hearth plants supplied to the above mine. Probably the most important advantage of this type of plant is that it will work continuously with colonial anthracite refuse, which is impossible with the ordinary suction gas plant fitted with fire bars and fire doors. Its features are the total absence of fire bars and doors, which enables the fire to be cleaned and clinkered while the plant is in full operation and without interfering with the production of gas.

In our opinion, it is obviously a plant which adapts itself to native labour on account of the accessibility for clinkering and simplicity of operation.

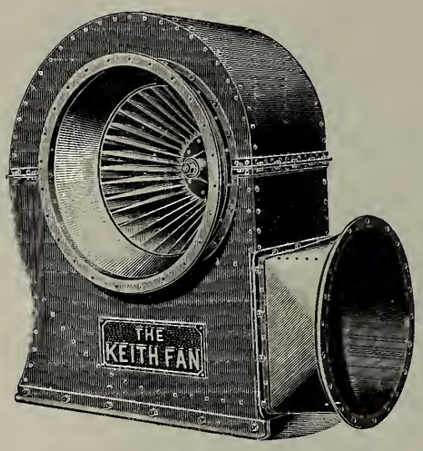


RAND MINING IN PICTURE



Bantjes Consolidated; Another View

BLACKMAN FANS



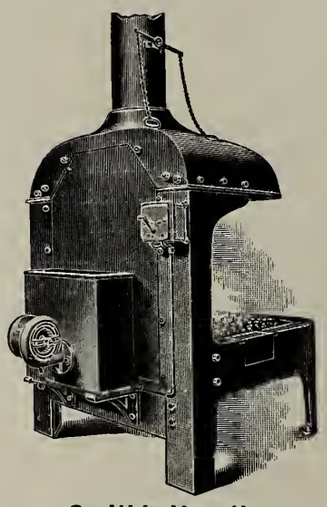
For
Ventilation and Dust
Removing



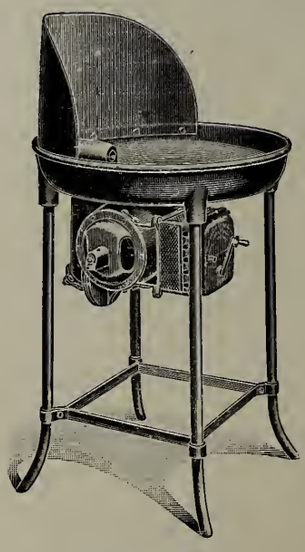
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Starting Up Suction Gas
Plants



For
Blast Furnaces,
Cupolas and
Forges



Smith's Hearth
with Motor combined



Portable
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Electrically-driven Air Compressors

WITH the increased application of electricity as a motive power on the Rand, especially in connection with surface plant on the mines, it was inevitable that steam-driven compressor installations would gradually be displaced by electrically-driven ones. That this did not come about sooner is undoubtedly largely due to the fact that steam-driven compressors are so easily governed and respond so readily to the very varying demand for air. Up-to-date machines, fitted with the best modern steam and air valves and equipped with an efficient speed and air governor, give a relatively high overall efficiency.

Turning to electrically-driven compressors, the most suitable three-phase motor for compressor driving being of the synchronous type, the output can obviously not be regulated by varying the speed, and some other means must be employed to regulate the supply. The old-fashioned and very wasteful way employed—largely with belt-driven machines—was to let the air blow off in the receiver; and the later method of decreasing the amount to be compressed, by throttling the suction, could also not be regarded as highly efficient. It, therefore, became necessary to seek some other means of attaining the desired end, and the attention of some makers was drawn to the possibility of controlling the air in the cylinders themselves. Messrs. Robey and Co., Ltd., of Lincoln, England, whose experience in air compressors extends over a long period, devised a method whereby this can be done with the highest efficiency. Particulars of their patent method of air control are given a little further on.

On page 8 of this issue are two illustrations of a thirty-drill machine installed by them about a year ago at the Meyer and Charlton Gold Mining Company, Limited. It is of the horizontal two-stage type, with cylinders 21 inches and 34½ inches diameter by 30-inch stroke. A three-phase synchronous motor built by Messrs. Siemens, Ltd., is mounted direct on the crankshaft, running at a speed of 107 r.p.m., the air being compressed to an ultimate gauge pressure of 80 lbs. In addition to an intercooler, the compressor is further equipped with an aftercooler, which lowers the temperature of the air before entering the receiver for use underground.

The valves on both cylinders are of the Robey patent automatic disc type, with special attachment dispensing with the use of guide studs or other supports which are liable to wear, the valves being quite free to set themselves absolutely accurately and noiselessly every stroke. The valves are held in position by means of coiled springs of square section, the springs fitting into the flanges on the outside and inside edges of the valve, the springs being held also at the other end by the guide plate. With this arrangement the valve is held firmly in position on the valve seat, and is free to move in all directions towards the guide plate, thus rendering lubrication unnecessary.

Inlet and outlet valves are identical in shape and interchangeable. They are corrugated in form, and made from a special quality of mild steel, thus making them not only extremely strong, but at the same time very elastic. The time required for examining a valve is reduced to a minimum by the special arrangement of copper joint and detachable seatings. The cost of spare valves and seatings is reduced to a minimum, and they can be replaced in a few minutes if required. The valves are multiple-ported, and therefore only a small lift is required, hence they are absolutely silent in action and wear practically disappears. These valves are illustrated in accompanying figures.



Inlet Valve. "Robey" Patent Air Compressor Valves. Outlet Valve.

The Robey patent automatic air governing device mentioned above consists of the following:—

An equilibrium valve is employed at each end of both the L.P. and H.P. cylinder, connected with the cylinder by a port. These valves are controlled by cams mounted on and driven from the lay shafts which run parallel with the engine beds and are driven direct from the crankshaft by skew gearing running in an oil-tight bath, both shafts revolving at the same speed.

The unloading valve opens in addition to the automatic disc valves during the whole of the suction stroke, and the cam is so shaped as to operate the

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valve according to the amount of air required to be delivered by the compressor, i.e., supposing the compressor to be only half loaded, the valve would remain open for half the compression stroke, thus allowing half the air taken into the cylinder on the suction stroke to flow back to the atmosphere or intercooler respectively. The point of the stroke at which the valve closes is variable from beginning to end of the stroke, thus enabling the compressor to be unloaded to any extent. The position of the cams is controlled by a sensitive air governor placed conveniently between the cylinders. For unloading when starting up, a hand wheel is provided which lifts the governor weights; this is shown at the side of the H.P. cylinder in the end view illustration.

The Robey patent automatic disc valves are, of course, equally applicable to horizontal or vertical compressors running at very high speeds, and a considerable number of these are in successful operation at collieries in Great Britain and elsewhere.



Mr. G. E. Webber, Late Consulting Engineer, Eckstein Group

The "Siskol" Drill in South Africa

THE name "Siskol" has been so prominently before the mining community of South Africa in the last few years that a short descriptive account of how the "Siskol" machines became associated with this market will not be out of place in this special issue. Some ten years ago a company was formed in England with the object of putting on the market a new type of coal-cutter. The venture was most successful, and the company gradually extended its sphere of operations and introduced further specialities to its numerous purchasers. The firm in question is International Channelling Machines, Ltd., whose "Siskol" coal-cutters, rock-drills, and kindred appliances are now to be found working successfully under manifold conditions in practically every mining country of the world.

In the coal fields of Great Britain the "Siskol" coal-cutter holds undoubted sway, and although constantly challenged by lower-priced rivals, it continues to forge ahead as the leading coal-cutter of its type. The official figures issued by the Government Home Office, setting forth the number and type of the various coal-cutters at work in Great Britain, furnish startling figures as to the extensive use of this machine and to its increasing sales yearly. "First in the Field and Foremost Still" was a motto adopted in this company's literature some years ago, and the Government returns prove conclusively that not only has this machine retained its position against all comers but that it has steadily increased its lead. The above can be verified by anyone who studies the Government blue-books. It must not be supposed, however, that the superiority of the "Siskol" coal-cutter is confined to Great Britain. This machine was very soon installed by the colliery managers in the Colonies, and the coal fields of South Africa, in particular, bear striking witness to the all-round superiority of the "Siskol." Several hundreds of these machines are working daily in all the principal collieries of the Transvaal and Natal, and even in such a scattered district as Rhodesia the "Siskol" holds its own. Repeat orders must surely indicate satisfied users, and many such orders have been placed and are at present in hand. In most cases the original orders for "Siskols" have only been secured after long and exhaustive competitive tests, and it speaks for itself when it is mentioned that all the orders which have been placed in South Africa during the past two or three years for percussive machines of this type have been for "Siskols." The success of the coal-cutter being well proved, International Channelling Machines, Ltd., then turned their attention to hammer-drills, and in these machines also they are doing a large and increasing business.

Spurred on by the results of their efforts, the Transvaal stope-drill competition gave them a further opening, and they decided to design a stope-drill and to enter it in competition with the best-known stope-drills in the world. The history of this competition is too well known among those interested in mining matters to need repetition here: suffice it to say that the "Siskol" was one of the four drills which survived this rigorous test, and it was ultimately awarded a first prize of £2,500. During the competition numerous alterations and improvements suggested themselves, and these have all been embodied in the most practical manner in the later models.

Much could be written as to the numerous and various records created and held by the "Siskol," but this would be rather outside the scope of this article. The makers are, however, always willing to furnish full details in these matters, and, what is more to the point, are always in a position to produce conclusive proof of the authenticity of their statements. Mention must not be omitted of the "Siskol" air-compressor, which, in keeping with other goods bearing this trade-mark, is of excellent design and is constructed from the highest-class materials by highly-trained men. It is arranged for belt-drive or can be coupled direct to an electric motor by spur gearing. This air-compressor is specially adapted for in-bye work and an excellent combination for development work in collieries is furnished by a complete "Siskol" outfit, consisting of an in-bye compressor, a coal-cutter, and a hammer-drill for boring the shot holes. Many such outfits are in operation and are giving complete satisfaction.

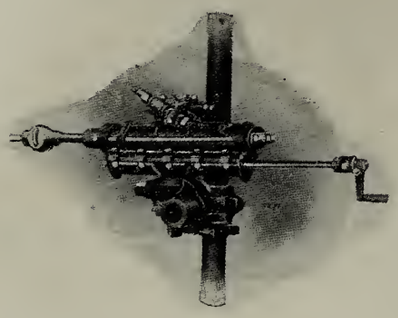
From the foregoing it will be seen that the "Siskol" products are no mushroom growth, but are the well-thought-out productions of a firm who have specialised in the various machines they offer to the mining world, and who have built up a large business on their own particular wares. International Channelling Machines, Ltd., have now branches and agencies in all the important mining centres, and in all cases the staffs employed are always in a position to supply those interested with details of the latest performances and records. The South African office is situated at 2-3, Trust Buildings, P.O. Box 1382, Johannesburg, and any information required will be furnished on application.

RAND MINING IN PICTURE



Princess Estate

COMPRESSED AIR



"Butterfly Valve" Rock Drill. (Type C-110)

PERCUSSIVE ROCK DRILLS

The first successful machine rock drill was one in which the cutting bit was fastened to, and reciprocated with the piston. This type is in use to-day and is known as the "percussive" or "reciprocating piston" type. It is the drill in most general use and is adapted for rock drilling in general.

The machine of this type that has proved the best in the past forty years, over a long period of years is what is known as the "Auxiliary Valve" type, the E-33 and C-35 sizes being the ones best known in South Africa. In design, material, workmanship and hardiness these drills are unequalled.

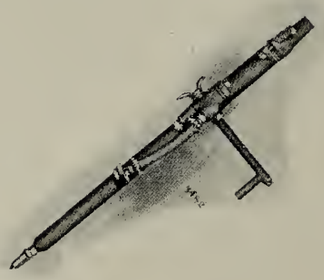


"Auxiliary Valve" Rock Drill. (E-33 & C-35 Types)

At the present day, in mining, they are used in development work in general, and in stoping.

The Ingersoll-Rand Company in the past two years has been selling what is known as the C-110 "Butterfly Valve" Drill. This machine during its existence has proved itself the fastest and lightest machine of its size (2¾in. cylinder) on the market. On the Rand in stoping it will average two holes more per shift than any competitor.

These machines are made in all sizes ranging from 2in. to 7in. cylinder diameter, according to the nature of the work.



Air-Feed Hammer Drill. (Type BC-21)

AIR-FEED HAMMER DRILLS

Hammer Drills differ from Percussive Drills in that the piston strikes the cutting steel instead of reciprocating it. The Air-Feed Hammer Drill is a machine of this type with a telescoping air feed instead of the screw feed generally used on the "reciprocating piston" type. This machine has been developed in the past five or six years. In its special class (back stoping, raising, cutting box holes and stoping where the reef is very narrow) it is far superior and the working costs much lower than any "percussive drill."

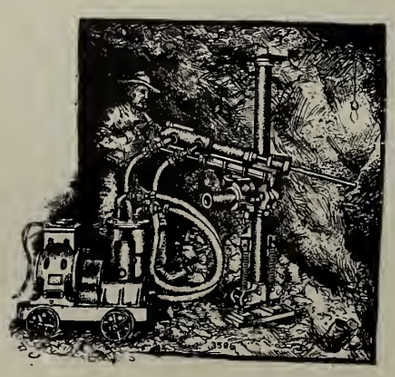
A drill, combining the best work possible of the most up-to-date factory with that of all the latest improvements, including the "Butterfly Valve," is the "BC-21" model. Among the prominent merits of the drill are simplicity and positiveness of valve, no screw joints, no small ports to clog and an automatic lubrication. Upkeep of these machines on the Rand averages about 10/- per month, being about one-third to one-fourth that of competitors.



Jackhammer.

ELECTRIC-AIR ROCK DRILLS

Electrical Engineers for some years have devoted much attention to the development of an electric rock drill. Electric power is so easily transmitted and so flexible that it was an easy matter to produce an electric drill which from the mechanic's standpoint was perfect. However, in actual practice all purely electric drills whether of the solenoid, flexible shaft, or loose gear type have proven a failure for various reasons. One point, however, was proven and that was that if electricity as a motive power could be used it would be very economical. The idea was then conceived of combining the economy of electricity with the ruggedness and power of the compressed air machine. This was successful and the Temple-Ingersoll rock drill as it stands to-day is the best machine where electrical and other conditions make it advisable to use a machine of this type.



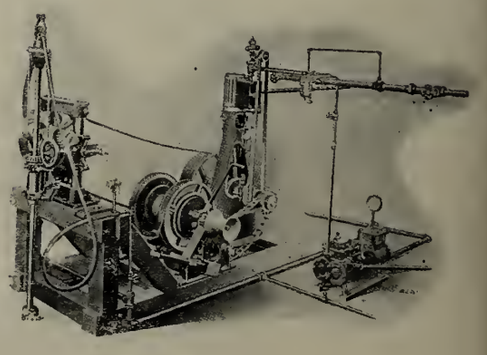
Electric-Air Rock Drill.

JACKHAMMERS

Light hammer drills that need no mounting and are held by hand have been manufactured for some years with indifferent success for heavy work. In South Africa, it remained for the "Jackhammer," an Ingersoll machine of this type, to prove that taking up footwall, winzeing, shaft sinking, hitch cutting, etc., can be done cheaper by machine than with hammer boys. They are light in weight (35 lbs.) and a fair day's work for a boy is about 25 feet of hole, where the usual hand work is one hole of about 3ft. 6in. in depth. The record for the Rand is 52 inches in 18 minutes at an angle of 45 degrees in a drive.

CORE DRILLS

Core drills formerly were all of the diamond drill type. Diamonds however for this class of work became so expensive that other methods had to be considered. Various methods have been tried, but each had some great defect and nothing replaced the diamond drill until the method of drilling by "chilled shot" was introduced. This method is so satisfactory that diamond drills are becoming things of the past. Chilled shot bore as quickly as diamonds, besides which an outfit of this kind gives a core of any diameter (2 feet if necessary), will do it cheaper and with less liability of losing a hole. They are also good for well drilling.

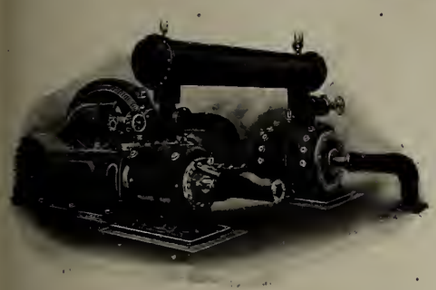


Calyx Core Drill. (With Chilled Shot)

INGERSOLL-

JOHANNESBURG

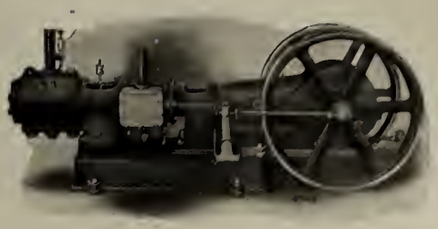
AND OTHER MACHINERY



Class "P
Electrically Driven Air Compressor

AIR COMPRESSORS

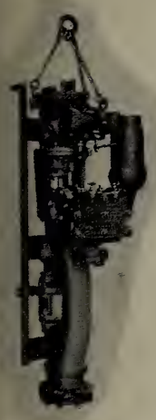
Compressed air at the present day is used for so many purposes and in so many ways that one type of machine is not sufficient.
The Ingersoll-Rand Company build a line of machines which includes every possible type that could be required. According to the conditions involved, they may be operated by steam, electricity, water power, gas engine or belt. In steam driven compressors they range from a small slide valve machine to the largest and most economical of the Corliss type, as well as the newest and best form of turbine. The electrically driven machines are gear driven in the smaller sizes, while in the medium and larger sizes the motor and compressor have a common shaft. In capacity and pressure they also cover every conceivable requirement. The smallest in capacity has a piston displacement of 4 cubic feet of free air per minute, and the largest has a capacity of 10,000 cubic feet, while the pressures vary from a few pounds such as is used in the agitation of liquids and converters to 3,000 lbs. for long distance compressed air haulage and other work. For a prospective buyer therefore it is absolutely necessary to get the proper type of machine.



Class "NF" Steam Driven Air Compressor

The Ingersoll-Rand Company have the best and most experienced corps of Engineers, the best equipped factories, the best machines and the best materials, therefore when you buy an Ingersoll machine you can feel that you are getting the best that money can buy.

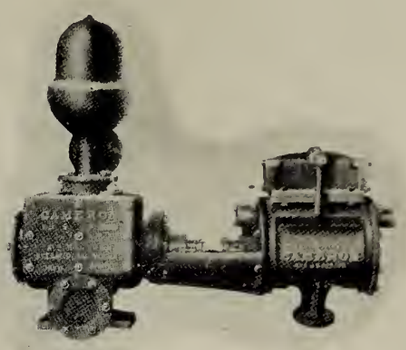
CAMERON PUMPS



Cameron
Sinking Pump

In discussing Cameron pumps it impossible in one short paragraph to give an elaborate discussion of the merits and demerits of different types. However it is sufficient here to say that the Cameron is built in every type that has been found necessary in the exploitation of mines. Its record for durability, simplicity and entire absence of external working parts, extending over a period of many years, has given it a reputation unequalled by that of any other pump in all the mining centres of the world.

The Cameron has fewer working parts than any other pump in existence. The steam mechanism is composed of four pieces only, none of which are delicate or complicated, and as they are all enclosed are not exposed to external injury. All the valve mechanism and other working parts, unlike other machines, are all enclosed. The construction also is such that the machine may be run without any load under a full head of steam or air without the pistons striking the heads. Whether as sinking or as station pumps, Cameron pumps may be depended upon to run every day in the year, and no mine should be without them.



Regular Cameron Pump

PNEUMATIC TOOLS

Under "Pneumatic Tools" are understood pneumatic hammers for chipping metals, driving rivets, and stone carving; boring machines for both metals and wood; pneumatic hoists, sand blast apparatus for cleaning castings, stone buildings, etc.; also sand shakers, painting machines and many other appliances. Chipping hammers are made in five sizes, and besides chipping are used for caulking, etc. Riveting hammers will drive steam tight rivets up to 1¼ inches in diameter. Drills will drill holes in metal or wood up to 3 inches in diameter. They are also used for tapping, reaming and flue rolling, and are very handy in repairing boilers, cages, buckets, etc. Portable hoists are also classed under this heading.



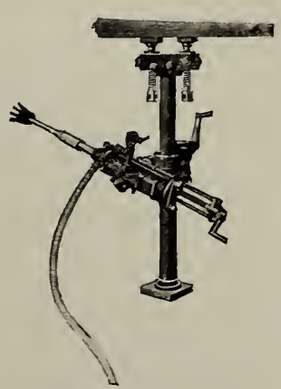
"Crown" Rotary Drill
for Metal and Wood Boring



Chipping and Riveting Hammer

COAL CUTTERS

Machine coal cutters operated by compressed air are divided into two classes, the "post" machine and the "puncher." In general the "puncher" is used where the seam is horizontal and where the coal breaks freely. The "post" machine, which is known as the "Radialax," is the one which is more generally used in South Africa. It is made in sizes ranging from 2¾ to 3⅝ inch in diameter and is capable of putting in a cut 12 by 8 feet. It will put in 3 to 5 cuts per shift according to the nature of the coal and the air pressure.



"Radialax" Coal Cutter

RAND CO.

LONDON



"New Ingersoll" Coal Cutter. (Puncher Type)

The Rand Native Labour Position

A Brief Review of the Industry's Paramount Problem

THE inevitable reference to shortage of native labour forms a feature of many of the latest returns from the mines. It is, of course, the season of shortage, and no reorganisation of recruiting can hope to change the ebb and flow of the black labour tide. In June a notable decrease was shown, due principally to a large number of natives having taken their discharge; the wastage figure at this time of the year is always strongly influenced by local climatic conditions. During June rather severe weather was experienced, and therefore it was not surprising that the wastage figure for that month was high. Mr. Elkan pointed out recently that, generally speaking, the position of native labour at the moment was not—taking into consideration that we were in the middle of winter—unsatisfactory, and as regards the recruiting returns received, he was able to state that they showed an increase—for the first seventeen days of June the figures were nine thousand and twenty-eight natives, as against nine thousand seven hundred and forty-eight for the corresponding period of July, thus showing an increase of seven hundred and twenty. Judging from past experience, he thought they must expect a further reduction in the number of natives employed by the mines during July. On the other hand, from the beginning of August the mines start receiving the first batches of new recruits from the latitudes north of twenty-two degrees south, and as this class of labour has caused much comment, it is noteworthy that the mortality figures for June show an appreciable reduction on the preceding month. Everything is being done by the employers of tropical natives to reduce the rate of mortality further, and satisfactory results are being achieved already. Possibly the worst rigours of winter are now over—the weather has certainly become milder—and boys may come back to work earlier than usual. Meanwhile, however, the great work of reorganising recruiting arrangements is proceeding apace, and it is understood that recruiters who come in direct contact with the natives will suffer the minimum of interference, and that "boys" will, as before, be allowed to go to work at the mine of their choice. The agitation which the Natal farmers and planters are attempting to work up is not considered a serious menace to the maintenance of the labour supply from that Province, because the ideas actuating the promoters are fundamentally wrong. The native cannot be hindered, short of force or illegal persuasion, from selling his labour in the best market for it, and, while the Rand remains the best market, it need not fear Natal competition. Already the farmers of that Province have secured the closing of many thickly populated native areas to Rand recruiters. That should content them. Yet another consideration affecting, indirectly, the Rand labour supply arises from the possible re-opening of questions with the Portuguese Province of Mozambique. The Union Minister of Railways and the Railway Board have been conferring with the Portuguese authorities at Delagoa Bay, but there is not the slightest reason to fear that any re-arrangement of railway rates that may be agreed upon by the high contracting parties will affect the native recruiting in Portuguese territory, that is essential to the prosperity of the Union and Mozambique. In this connection, it is noteworthy that anyone who still cherishes the hope of seeing the Chinese return to this country—our farmers appear to be the last to cherish the fond idea—will find in the speech made by the Minister of Mines at a function held in honour of the Imperial German Colonial Secretary recently an emphatic reminder of its impossibility. The Union Government is not likely to accede to the farmers' wishes—Rand mining people banished the idea years ago—in view of Mr. Malan's declaration on the subject. To sum up the position, the native labour problem, despite all the thought devoted to it, is still the most serious trouble the industry has to face; all mines suffer from it to some extent; some mines suffer to a serious extent, and one or two mines, in trouble from other causes, find by it their troubles aggravated enormously. Fortunately, the worst part of the year is nearly over, and the coming months are bound to see an amelioration of the position, making for improvement all round.

Victoria Falls and Transvaal Power

A Prosperous Position Review of the Finances Bright Outlook for the Undertaking

THE total share capital of the and debenture Victoria Falls Power Company in issue stands at £7,000,000. The year's business has resulted in a profit of £323,093, which, with the balance at the credit of the profit and loss account as at December 31st, 1910, remaining after payment of the dividend declared at the last general meeting, makes a gross total of £360,943. After providing for interest on debentures and income tax thereon for the year 1911, amounting to £124,736, and for depreciation amounting to £61,264, the balance remaining is £174,943, as shown in the balance sheet. In respect of this balance, the directors declared a dividend at the rate of six per cent. per annum, paid on June 14th, 1912, which absorbed £129,198, leaving £45,744 to be carried forward. The profit shown in the accounts has been secured by sales of power from the Brakpan and Simmer Pan stations, and from profits received in respect to the company's holding in the Rand Mines Power Supply Company. The directors report "a period of sustained progress during the year 1911 and down to the present time." The results obtained from all the stations continue to give entire satisfaction, and now show an increase in profits month by month. The erection of the power stations of the two companies has practically guaranteed a regular supply of power to the Rand mining industry at a very reasonable price, with the result that the companies have received demands for an increased supply of power from consumers, who are entitled, under long-term contracts, to be supplied with the power they require. The company has received applications for power supplies amounting to 52,000 h.p. and the Rand Mines Power Supply Company for supplies of electricity of 67,000 h.p. and of compressed air of 66,000 h.p., making a total notified demand of 185,000 h.p. When all the extensions to the stations for which arrangements have been made are completed the combined plants of the two concerns will have a capacity of 232,000 h.p. During the year under review the chairman paid a visit to South Africa, where he was engaged for two months in Johannesburg on the business of the company.

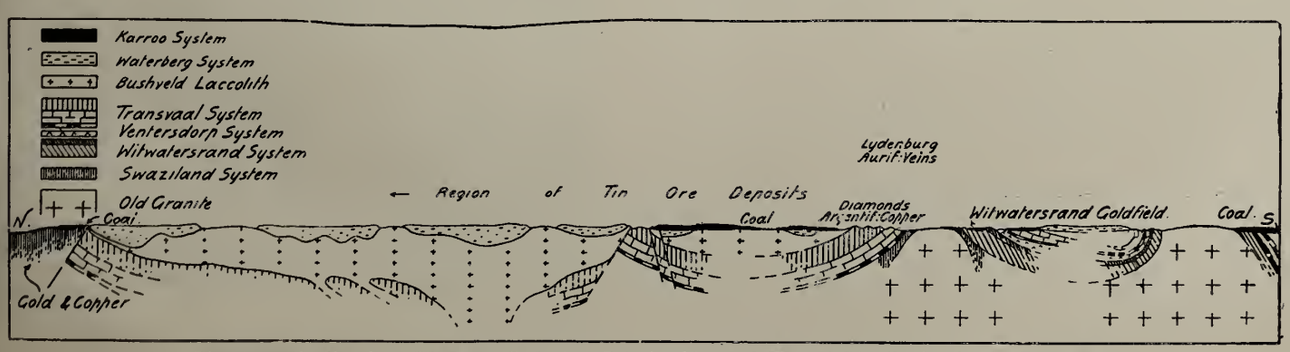
The Transvaal Tin Deposits

An Account of the Geological Features of the Occurrences in the Waterberg District of the Transvaal

IN a recent article upon the "Geological Features of Tin Deposits," in "Economic Geology," Messrs. H. G. Ferguson and A. M. Bateman have summarised the more striking geological features associated with the occurrence of tin ores in various parts of the world, and upon this basis have endeavoured to establish criteria which may prove of value to mining engineers and geologists. The most striking geologic feature of tin deposits, they remark, is their very general association with acid intrusives. In nearly every case the deposits are to be found either in the near neighbourhood of granite or actually in a granite country rock. This granite in all cases forms an intrusive body or bodies, which are later than the surrounding rocks, and whose intrusion has immediately preceded the mineralisation.

"The geologic age of the intrusives and the deposits dependent upon them is often impossible of close determination. The age of tin deposits ranges from Archean to late Tertiary. The periods of igneous intrusion at the close of the Carboniferous and during Mesozoic times seem to have been particularly favourable for the tin-bearing granites. Although the intrusive granite sometimes occurs in dykes, it is most commonly in the form of a batholith; that is, a vast irregular body having indefinite downward extension. These batholiths were intruded under a heavy cover, and their surface area, therefore, varies with the amount of erosion and the original irregularity of their upper surfaces. It is a characteristic of the batholithic method of intrusion that the dips of the contact should show great local variations." The irregular shape or superficial contour of these intrusive masses, and the degree to which the surfaces and outer portions have been eroded by denudation, have an important bearing upon the number and extent of the tin deposits that are likely to be exposed at or near the surface, as will be seen from the following statements: "Wherever tin deposits accompany a batholithic intrusion of granite it has been found that the deposits occupy positions at or near the summit of the batholith. Hence the extent to which the granite has been eroded is a very significant factor. . . . Where denudation has exposed only the upper portion of the batholith, since deposits tend to accumulate in such upper portions, they may be looked for over any part of the exposed granite area in almost their original proportions. On the other hand, in regions where denudation has extended deeper into the batholith, it may be expected that deposits originally existing in the upper portions would be removed, perhaps to form placers, and that the central portions will contain only the stubs of the pre-existing veins, or be altogether barren. In this case, the probable position for a tin deposit would be near the border of the batholith."

In a general way, these statements apply to the conditions under which the tin deposits of the Transvaal are found to occur. The batholith intrusion is represented by the huge igneous mass known as the Bushveld Plutonic Complex, a group of rocks resulting from the differentiation of a magma which burst through the strata of the Pretoria system in Devonian times, and, failing to overcome the weight of the overlying Waterberg strata, spread itself out beneath them over an area which has been roughly estimated at about fifteen thousand square miles. "Comprised in it," remark Hatch and Corstorphine in "The Geology of South Africa," there is a great variety of rock-types, varying in chemical composition from acid to ultra-basic. They are apparently genetically related, being probably derived by a process of segregation from one original magma. At the extreme western end of the complex in the Marico district, felspar-free ultra-basic rocks occur as peridotites and pyroxenites. Eastward, zones of gradually increasing acidity are traversed; first norites and gabbros, then nepheline-syenites, and finally "red granite in which quartz is usually an abundant constituent." This is a summary of the rock-types from the periphery of the batholith towards the centre that may be used to describe the passage from the edges inwards along almost any radius. It is with the "red granite" that the tin deposits are mainly, if not entirely, associated. In its simplest form the occurrence may be diagrammatically shown thus:—



Diagrammatic Sketch to Illustrate Geological Relationships and Mineral Distribution in the Transvaal

The Sedimentary Formations.

The principal sedimentary formations with the associated contemporaneous igneous rocks represented on the Waterberg tin fields are shown in descending order in the following table, as given by the Geological Survey of the Transvaal:—

Bushveld Amygdaloid Bushveld Sandstones		Karroo System.
Sandstones and Conglomerates	Upper	Waterberg System.
Felsites and Shales ... ... (Volcanic Series)	Lower	
Quartzites and Shales (Rooiberg Beds).		
Main Batholithic Mass.		
Quartzites and Shales ...	Pretoria Series	Transvaal System.
Banded Magnetite Quartzites Dolomitic Limestone ...	Dolomite Series	
Quartzites	Black Reef Series	

Unconformity exists between each of the three systems named above. The igneous rocks of the Bushveld Plutonic Complex are extensively intruded into the Transvaal and Waterberg systems, and into the older plutonic rocks, mainly granitic in character, which underlie the Transvaal system and older formations, and which are commonly known under the term of older granite. Of the rocks mentioned in the foregoing table, the Karroo and Transvaal systems take a comparatively unimportant share in the structure of the tin-bearing area, the red granite and the felsites and sedimentary strata of the lower portion of the Waterberg system being mainly the enclosing rocks of the tin deposits hitherto discovered in the Central Transvaal. This is easily understood when the tendency of the tin-bearing gases and vapours to rise upwards is borne in mind, and when it is explained that the intrusive activity of the granite magma had practically ceased before the upper portion of the Waterberg system began to be laid down.

The Waterberg System.

In view of the importance of the Waterberg system in the great development of tin ore deposits which followed upon the vast batholithic intrusion of the Bushveld, the following brief description of its component beds, taken from reports of the Geological Survey of the Transvaal, will be of interest:—

The Rooiberg series, the lowest known to exist in the system, occupies a comparatively small area of the tin country in the neighbourhood of a range of hills of that name. The series consists in the main of felspathic quartzites, arkose, and shales, with which are associated some felsites and diabases, and is overlain by a thick sheet of felsite belonging to the volcanic series above it in the same system. When first examined by the Geological Survey, these beds were provisionally placed in the Pretoria series until further investigation should determine their true relationships. Later investigations have left little room for doubting that they are really a portion of the Waterberg rocks, as shown in the tabular statement given above.

The base of the Rooiberg series rests upon granite which bears an intrusive relationship to the lowermost quartzites. The beds along the contact show considerable alteration, being rich in felspar, and especially in tourmaline, which often occupies the bulk of the rock, and consists of blue, brown, and colourless varieties. No definite information is available with regard to the probable thickness of the series. R. Recknagel, sometime consulting engineer to the Rooiberg Minerals Development Company, Ltd., considered that it amounted to several thousand feet, while Humphrey, of the Geological Survey, puts it, apparently, at between one and two thousand feet. The lowermost group of quartzites in the highest horizon of which the shafts of the company have been sunk are stated by him to be "of considerable thickness, at least five hundred feet."

The area covered by the Rooiberg series is in parts richly mineralised, tin being the most important economic product yet developed. A large number of ancient workings remain to show that some bygone race, of whom no tradition or record remains, was at one time actively engaged in mining tin ore in these parts. The area covered by the old workings in the neighbourhood of the Rooiberg tin mine covers a space of over seventy acres, and within that area there is little ground that has not been turned over to some extent, the depth attained being probably not more than thirty feet or so. Tin smelting was carried on also, as proved by the discovery of a few tin ingots, broken pieces of tuyeres and smelting pots. Very little ore was left in the dumps, and it was only after exploration had been made by means of shafts on the site of these old workings that the actual object of the labour of the old miners was ascertained.

The tin in the Rooiberg area occurs in two definite and contrasting modes: (1) Associated with massive tourmaline, the cassiterite occurring in crystals disseminated throughout the tourmaline, in in layers separated from each other by tourmaline; (2) as a mixed ore without definite arrangement, consisting of cassiterite, hæmatite, malachite, and azurite.

In occurrences after type No. 1, the tourmaline is always looked upon as an indicator, and the tin is only found in association with it. At the same time, tourmaline often occurs in large masses without carrying tin. The ore is found in fissure veins, or lodes, and pockets. The lodes coincide with definite lines of fissure which appear to form a complicated network affecting a considerable area, extending far beyond the limits of the old workings referred to. They are usually steeply inclined, and consist chiefly of two main systems, the one with a west-north-west and east-south-east direction, and the other tending generally north and south. In other parts, nearer the edge of the quartzite area, the tin fissures have a much lower inclination.

The pockets consist of irregular bodies of mineralised quartzites, sometimes attaining considerable dimensions, and usually connected with fissures. They are characterised chiefly by the presence of tourmaline and cassiterite



Openings at top of Pipe No. 13, Zaaiplaats

occurring as replacements of part of the constituents of the quartzite, while other minerals, such as iron-lime carbonate, felspar, and quartz, may also be present, and there may sometimes be a roughly concentric arrangement of these replacing minerals. In addition to, and doubtless closely connected with, these pockets there are also mineralised bodies of a more regular form, more nearly related in mode of occurrence and formation to the bedding planes of the quartzites, and hence termed "bedding impregnations." Certain beds may be thus sometimes impregnated with tourmaline for some distance along the strike.

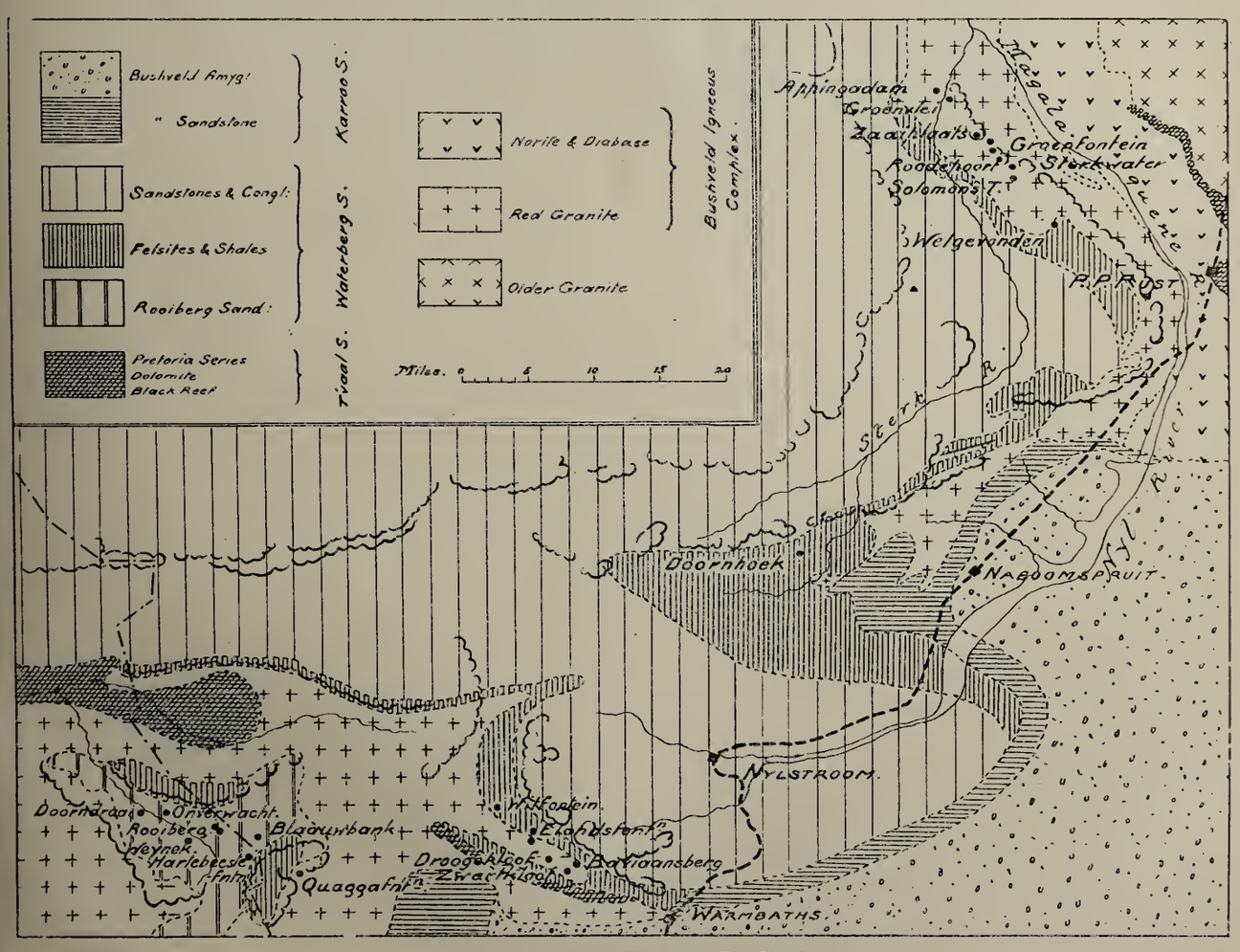
The impression formed by an examination of the tin deposits in this neighbourhood is that the mineralising vapours not only availed themselves of the easy channels afforded by the fissures directly created in the strata by the batholithic intrusion, but that they simultaneously, and subsequently also, forced a way along the bedding planes intersected by these fissures and formed within them, by replacement, subsidiary ore masses of large extent. So far has this subsidiary process been carried out that at the Rooiberg tin mines as much ore has been derived from the so-called secondary sources thus provided as from the workings situated directly along the main fissure planes. In the case of the low-dipping fissures nearer the edge of the Rooiberg series, two roughly parallel lodes dip towards the granite at an inclination of about sixteen degrees, cutting across the quartzites, which dip at an angle of about ten degrees in the opposite direction. One of the lodes is accompanied by a dark, fine-grained, greenish rock, with a shaly appearance, which is most probably a basic igneous variety, allied to diabase, forming an intrusive sheet along which the lode has subsequently been formed. Subordinate veins, of small extent, running into the bedding planes of the quartzite are in evidence. Mining operations were carried on here by the Weynek Tin Company, but the venture was not successful, and the mine has been closed down.

Waterberg Felsites and Shales.

The remaining portion of the Lower Waterberg system in the tin belt consists of a thick series of volcanic rocks, mainly felsitic in character, with interbedded shales on at least one horizon. Throughout the greater part of the country this group of rocks is found lying directly on the red granite, as will be evident from the accompanying general map of the region. The felsites are true volcanic rocks, and in many cases show the characteristic features of lava flows, including beautiful flow-banding, slaggy and amygdaloidal structures, and flow brecciation. Closely associated with them is a well-marked series of shales, hard, and with a flinty or felsitic appearance, and considerably indurated both from the influence of the felsite which flowed over them subsequently to their deposition and that of the granite outburst which occurred at the close of the Lower Waterberg period. The whole group is representative of a succession of lavas and sedimentary rocks, which is far more extensively developed in other parts of the Transvaal. The thickness of the felsites in the northern portion of the tin belt shown upon our map is estimated as being probably not less than three thousand feet, of which one thousand four hundred feet lie below and one thousand six hundred feet above the shale horizon. The thickness of the shale series in the northern exposures is considered to be between five and six hundred feet, so that the thickness of the whole felsite shale group is, roughly, between three and four thousand feet in the district referred to.

Upper Waterberg Beds.

The Upper Waterberg division, comprising a thick series of conglomerates, grits, and sandstones which form the most characteristic and easily recognised portion of the Waterberg system, almost everywhere in the tin region rests directly upon the felsites and shales of the lower division. The junction is, however, an



Geological Map of the Waterberg Tin District

unconformable one, and is usually marked by the occurrence of beds of coarse conglomerate, which frequently exceed one hundred feet in thickness, and occasionally, taken together with a few insignificant sandstone bands, attain two or three hundred feet. This conglomerate horizon usually forms a conspicuous feature in the local geology, and serves as a convenient and easily recognisable geological landmark. The unconformity between the two divisions of the Waterberg system is further marked by a difference in dip, the strata of the upper division being somewhat less steeply inclined. From evidence afforded by the conglomerates, consisting of red granite boulders, and in some localities of boulders of tourmalinised rocks, together with the indisputable fact of unconformity below the conglomerate horizon, it is to be concluded that the Upper Waterberg sandstones and conglomerates are of later age than the red granite of the district, and also later than the period of mineralisation which doubtless followed closely upon the intrusion of the granite, and was responsible for the introduction of the tourmaline, cassiterite, and other characteristic minerals.

On the other hand, it can be shown in other localities that portions of the red granite are clearly intrusive into, and therefore of later age, than the Upper Waterberg. Further evidence of the prolonged activity of the Bushveld magma is found in the intrusions in the upper sandstones of diabase, felsites, etc., and of special significance in this connection is an intrusion which shows a transition from diabase to an acid granophyre, and indicates that late in the Waterberg period, or probably subsequent to it, intrusions took place with characters identical with those of the more extensive and earlier portions of the Bushveld Plutonic Complex.

"The above phenomena," observe Kynaston and Mellor, of the Geological Survey, in their memoir relating to the Waterberg tin fields, "though at first sight of a somewhat contradictory nature, are by no means rare in ancient volcanic regions, and of such a region we have a good example in the Red Granite Waterberg area of the Central Transvaal. The strictly volcanic phase of this region is represented by the felsites and associated agglomerates and tuffs of the Lower Waterberg, together with which we find occasional intercalations of shales and sandstones. Following these eruptions, we have an intrusive period marked by the invasion of these lavas and sediments by an extensive portion of the Red Granite, whose petrological relationships point to it as most probably simply the deeper-seated or plutonic phase of the same magma from which the lavas were first of all derived. Further, there is good evidence for placing at the close of this intrusive phase the period of widespread mineralisation which was responsible for the deposits of cassiterite and other base metals, and which has now become such an important factor in the economic development of this portion of the country. Subsequently to this period were deposited the massive sandstones and conglomerates of the Upper Waterberg, and finally the general igneous activity of the area was concluded by later intrusions into the sandstones of red granite diabase, etc."

The diabase instrusions mentioned occur in the Red Granite and in the Lower and Upper Waterberg rocks. The majority take the form of intrusive sheets, true dykes being less frequently met with. They have, in most cases, apparently no special connection with the cassiterite deposits, being probably of considerably later age.

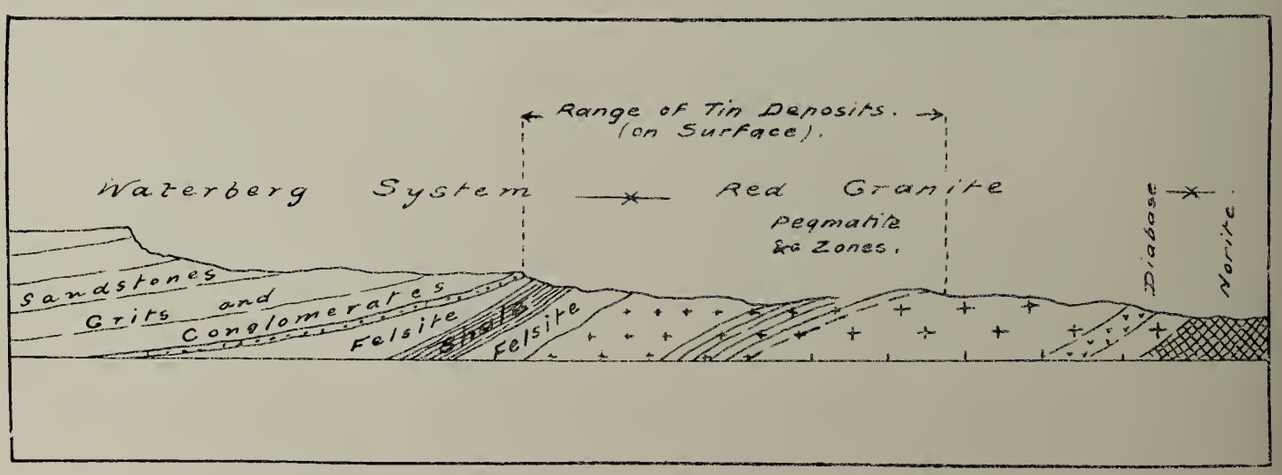
The thickness of the upper division of the Waterberg system, from the basal conglomerate to the edge of a plateau which marks the upper limit of its greatest development, is somewhere about eight thousand to nine thousand feet.

The Transvaal System.

The Transvaal system shows only a small development in the area occupied by the tin fields, and where it occurs it is usually much broken by faulting and igneous intrusions, and complicated in structure, and the succession characteristic of those areas where it is typically represented is absent. The present situation and behaviour of the system is doubtless in great part due to the extensive movements consequent upon the intrusion of the Bushveld Plutonic Complex. The general behaviour of the strata suggests a gradual overwhelming of the sediments by the igneous rocks, apart from a thinning out which is observable in that region.

The Red Granite and Associated Intrusions.

The red granite—the most important member of the Bushveld Plutonic Complex—is closely associated with the Waterberg system throughout the area. It is, on the whole, remarkably uniform in composition, modifications of a well-marked character being only rarely met with, and for the most part tending to appear near the contact with the norite in the marginal part of the batholith in that region, where they are associated also with intrusions of diabase. Thus a fairly well marked zone of aplites, diorites, and medium-grained granites is developed, following roughly the margins of the diabase, along the lowest zone of the Red Granite.



Diagrammatic Section showing Range of Principal Tin Occurrences, N.W. Waterberg

"Variations in texture," to follow the description of Kynaston and Mellor in the departmental memoir already mentioned, "though often purely local, are common and characteristic, and sometimes constitute a differentiation into zones, distinguished by special textural features. This differentiation is particularly well developed in the northern portion of the area, especially about Zaaiplaats, Groenfontein, and Solomon's Temple, and is of special significance in connection with the occurrence of the

cassiterite deposits. Thus, in this part of the area, in traversing the granite ranges from the Magalakwin towards the Sterk River, the deepest and lowest zone in contact with the norite is seen to consist of the aplites, diorites, and granites already referred to above, of a medium to fine-grained character. This is gradually succeeded by a much broader zone, which probably constitutes the main bulk of the granite, consisting of a coarse, massive, reddish rock, weathering into bare, rounded hummocks and large boulder-like masses, and building up the bold north-eastern buttresses of the main range, so conspicuous on Roodepoort, Groenfontein, and Sterkwater. This coarse granite gradually passes upward into a more medium-grained phase, showing a uniform granulitic or aplitic type of structure, which apparently attains its maximum development on Roodepoort, Groenfontein, and Solomon's Temple, but thins out gradually to the north-west, being only feebly represented on Zaaiplaats. This variety is succeeded by a well-marked, relatively fine-grained, usually red rock, characterised throughout by a very perfect development of the granophyric structure, and forming a rough and broken surface strewn with small boulders and sub-angular blocks, thus contrasting in a marked manner with the bare rounded surfaces of the coarser type below. The lower portion of this zone often shows a strong tendency to a platy or pseudo-bedded structure, which maintains a definite dip and strike over long distances, and gives rise to the well-marked escarpments which rise about the crests of the granite range and slope gently away to the south-west towards the overlying felsites.

"Between the zone of red granophyre and the underlying coarser granites there is developed, in the Potgietersrust tin fields, a well-marked narrow zone of coarse pegmatites. Their general behaviour and mode of occurrence is that of a flat vein or sheet, with a dip of from twelve to fifteen degrees in a general south-westerly direction, in accordance with the general inclination of the associated zones in the granite. This pegmatite band thus appears to occupy a definite 'horizon' in the granite mass."

It is of remarkable persistence in the neighbourhood, extending over a distance of many miles, and it is, moreover, of special interest in connection with the frequent close association with it of cassiterite. It constitutes, as it were, the upper boundary or limit to the cassiterite deposits of the main portion of the field in which it occurs. It frequently carries coarse cassiterite and other minerals in its lower portions, more especially where brecciated by small local movements, and a considerable number of ore-bodies in the shape of "pipes" and "flats" have been located almost immediately beneath its line of outcrop. Only in few instances have any rich deposits of ore been found and worked in the pegmatites; and even in these cases they are apparently not persistent. As a rule, the pegmatites in which the cassiterite occurs show considerable alteration of the same general metasomatic character as that found in connection with the deposits in the granite. Under these conditions it is difficult to regard the cassiterite and its associated minerals as original constitutents of the pegmatites, and one must conclude that, as in the case of the granite, so in the pegmatites they are of slightly later introduction.

Small irregular pegmatite bodies frequently occur in other portions of the granite mass, both above and below the particular zone above described, and especially near the contact with the felsites, on the one hand, and with the norites at the base of the red granite on the other. They do not appear, however, to have any special significance or importance from an economic point of view. "From the evidence available," say Kynaston and Mellor, "there is no reason to suppose that pegmatites are of more frequent occurrence or of special significance in tin-bearing portions of the granite than in other portions. Their occurence, however, in areas of mineralisation, while it may have no special connection with the mode of origin of the particular ore there deposited, may have an important bearing on the mode of occurrence of the ores, since the frequent association of ores with pegmatite bodies and veins in the granite would appear to indicate that the presence of the latter in regions of mineralisation may often, under favourable conditions, be taken advantage of by fissure-forming movements and the subsequent ascent of mineralising solutions."



View of Groenfontein Mill and Dressing Plant.

The different zones in the red granite, between the felsite and norite in that part of the tin belt where these zones are developed may be summarised as follows in descending order:—

(5) Zone of red granophyre.
(4) Zone of pegmatites.
(3) Zone of medium-grained granulitic granite.
(2) Zone of normal coarse granite.
(1) Zone of finer-grained granites, aplites, and diorites.

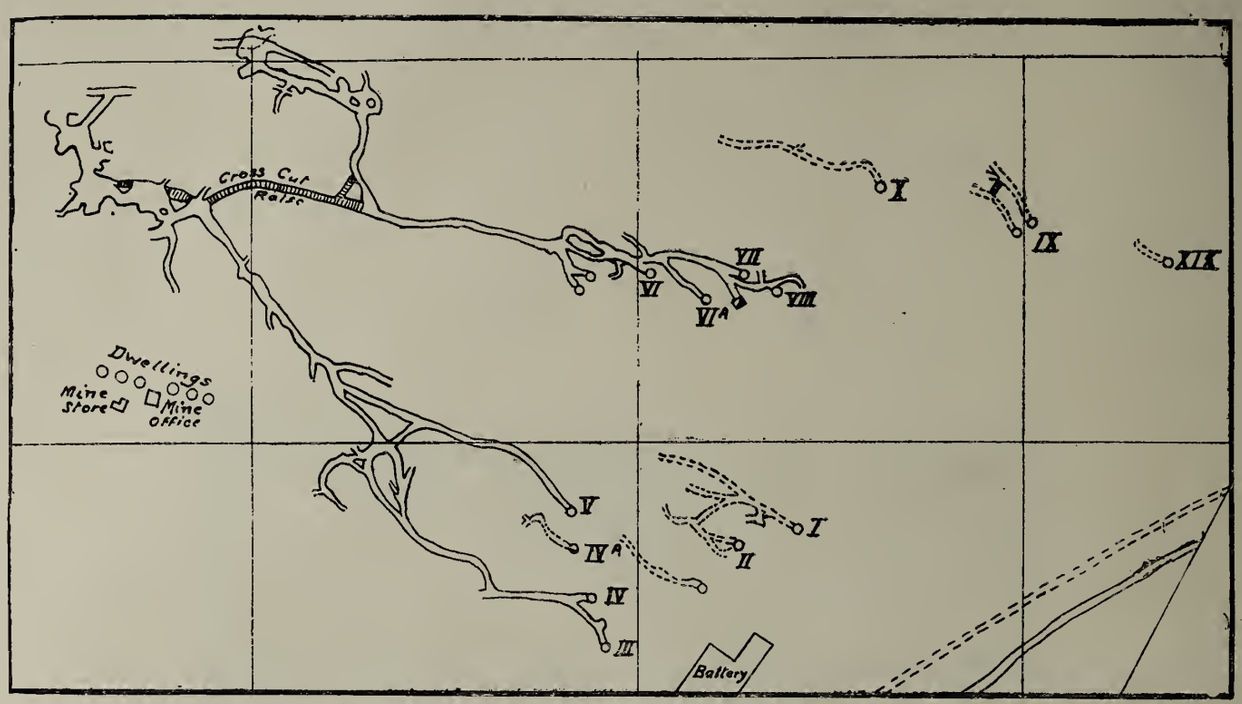
In the southern portion of the area similar varieties to those mentioned above may be observed locally, but differentiation into zones usually cannot be detected, though the finer-grained marginal portions of the granite are almost invariably rich in micro-pegmatite, and closely resemble the uppermost zone of the northern area, while the main mass of the granite corresponds to zone No. 2.

Main Features of the Tin Field.

Throughout the main portion of the northern area, which extends from Zaaiplaats to Solomon's Temple, the principal deposits usually occur in the form of elongated, more or less cylindrical pipes. These pipes are not found above the pegmatite horizon, and appear to be most numerous and rich on and in the vicinity of the Zaaiplaats Company's ground. Many thousands of tons of high-grade ore have been taken from some of the pipes, and at Zaaiplaats, where they have been worked in one instance to a depth of twelve hundred feet on the incline, the ore body appears as strong and rich as ever. Some doubt formerly existed with regard to the mode of origin of this type of deposit, but developments in depth in the Zaaiplaats mine tend to show that they are associated with fissures and probably originated along their lines of intersection. The extreme irregularity of their windings in depth may be attributed in the first place to the fact that the mineralising gases and vapours, in their ascent through the granite, changed their course from one place to another along lines of least resistance. The abrupt termination of the ore deposits at and below the pegmatite horizon may be explained in a similar way, and the absence of tin occurrences in the overlying granophyre may be explained on the assumption, which is based on satisfactory evidence, that the latter is a distinct and later intrusion than that of the main granite mass in those parts. To the north of Zaaiplaats the pipe form of deposit appears to give place to lenses and bodies more definitely associated with planes of fissuring. In addition to pipes, there are found, particularly on Roodepoort, immediately to the south, large masses of tin-impregnated granite of a grade, however, too low to permit of economic mining. Another type of deposit in the vicinity is that which occurs as a "flat" in the pegmatite horizon. It is sufficiently continuous in places to pay for exploitation upon an extensive scale.

In the southerly extension of the main tin zone on Welgevonden and Welgelegen the occurrence of cassiterite appears to be confined to the immediate neighbourhood of the line of contact between the felsites and the underlying granite.

Still further south, on Doornhoek and the adjoining farms along the tin belt, cassiterite deposits are found in the band of shale interbedded with the felsites of the Lower Waterberg, and also in the felsites immediately underlying the shales. In the shales the deposits are usually associated with well-defined lodes corresponding to lines of fracture and brecciation, and also in small veins; while in the felsites they are of a less definite character, and occur rather as small, irregular veins, patches, and pockets, often carrying coarse cassiterite, and sometimes distributed over a considerable width of country rock. Further to the south-west and west the cassiterite deposits occur either within the granite itself or in the felsites which overlie it, and are for the most part associated with lines of fissure and pegmatite bodies in the granite, and with crush planes and fissures in the adjacent felsites. The deposits lie in the neighbourhood of the contact, and upon both sides of it for an indefinite distance.



Plan showing tendency of "Pipes" to follow Planes of Fissure, Zaaiplaats Mine

Finally, in the Rooiberg district, at the extreme south-west of the belt of tin country, the ore-bodies are found in the fissured quartzites which lie at the base of the Waterberg system. The red granite crops out around the quartzite area, and undoubtedly underlies the whole of it, but it is impossible to say at what average depth from the surface at any place where mining operations are at present in progress.

The following summary of the distribution and general character of the Waterberg cassiterite deposits is given in the memoir of the Geological Survey already alluded to, and from which most of the geological data so far collated in these notes have been obtained :—



View of Zaaiplaats Mill and Dressing Plant

(1) The cassiterite deposits occur either in the Red Granite or in different strata of the lower division of the Waterberg system.

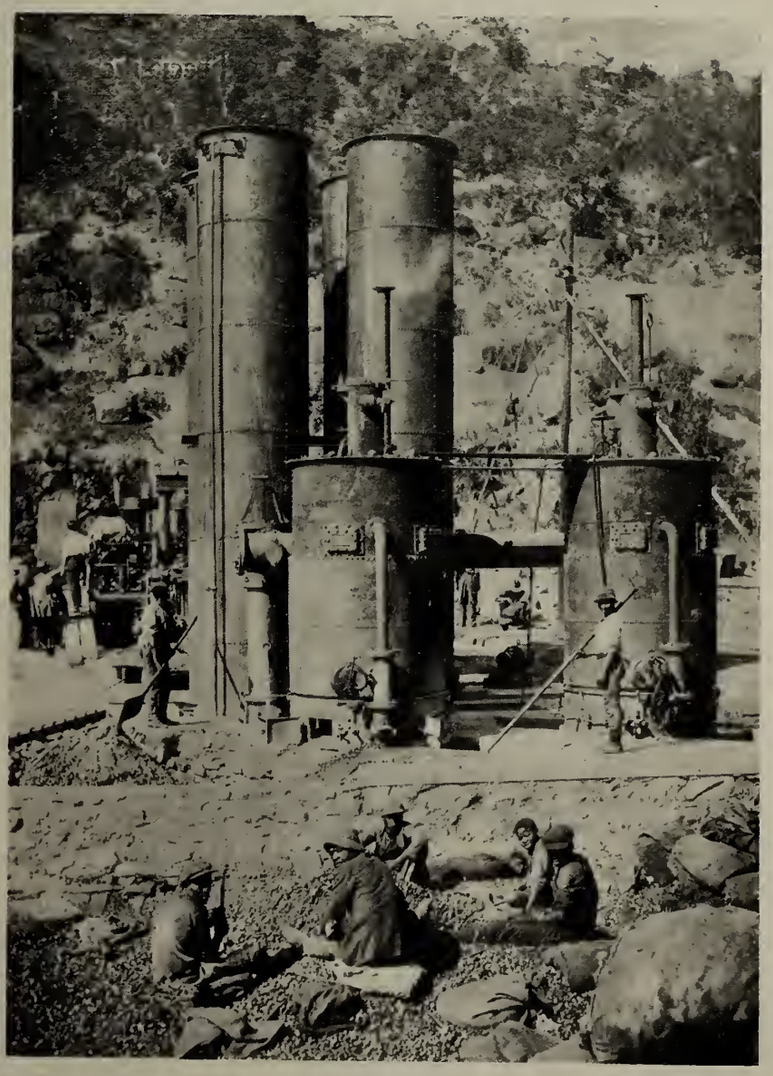
(2) They are in almost every case situated at no great distance from the line of contact between the Red Granite and the Lower Waterberg, and sometimes at the actual contact itself.

(3) Geologically associated as above, the deposits are found along a line of country extending from the neighbourhood of the junction of the Sterk and Magalakwin Rivers, south-eastwards towards Potgietersrust, and further south they occur again to the north of Nylstroom. Between here and Warmbaths the tin belt is concealed by the Upper Waterberg sandstones and conglomerates. West of Warmbaths, the zone of deposits extends for some distance in a south-westerly direction from Zwartkloof, and then reappears in the Rooiberg.

(4) In the red granite the cassiterite deposits occur: (i.) In the form of roughly cylindrical elongated pipes; (ii.) associated with irregular bodies of altered granite, sometimes more or less lenticular in shape, and following a definite "horizon" or zone in the granite, though often indefinite both in form and direction, and determined by various lines of weakness in the country rock. These types apparently graduate into the pipe form of deposit, on the one hand, and into (iii.) irregular disseminations in slightly altered granite; (iv.) as impregnations along well-defined lines of fissure; (v.) associated with pegmatite and quartz veins.

(5) In the felsites, shales, and quartzites the deposits are found: (i.) In lodes and more or less definite lines of fissure, small veins, veinlets, and leaders; and (ii.) as irregular patches and pockets, often connected with fissures or determined by planes of stratification.

GROENFONTEIN TIN MINE



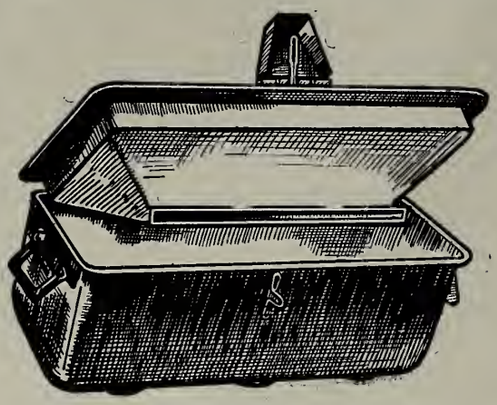
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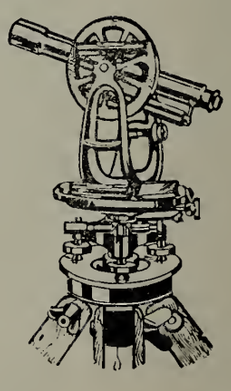
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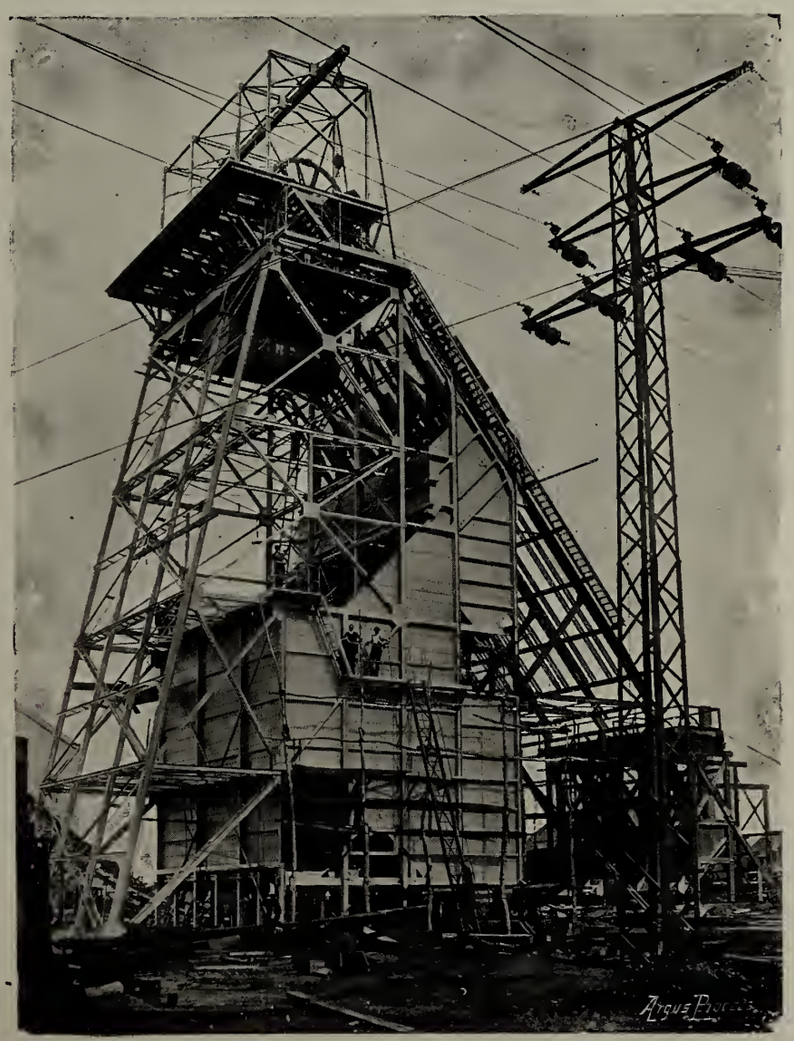
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The Metallurgy of the Rand Banket

A Short Description of the Various Processes carried out to Recover the Gold Contents of the Ore

IT has been well remarked that "the relative simplicity of the chemical problems presented in Rand metallurgy is a favourable condition which has rendered possible the low total cost of efficient treatment of the ore for under the value of one pennyweight of gold per 2,000 lb. ton." (Dr. W. A. Caldecott). The comparative simplicity of the treatment problem is a fortunate circumstance indeed, for although the Rand is the largest, richest, and most productive gold field in the world, it is essentially what is termed in mining phrase "a low-grade proposition," and the success with which it is now being worked, and will be worked in the future depends almost entirely upon the facilities which are afforded of dealing with large quantities of ore by mechanical means, as cheaply as possible, unhindered by the difficulties and perplexities of a complicated metallurgy. The chemical processes best suited to the recovery of gold from the banket are so thoroughly well applied and their probable results are susceptible of such close calculation that metallurgists are able to devote ample attention to the improvement of the methods employed from the all-important standpoint of capital expenditure and working cost.

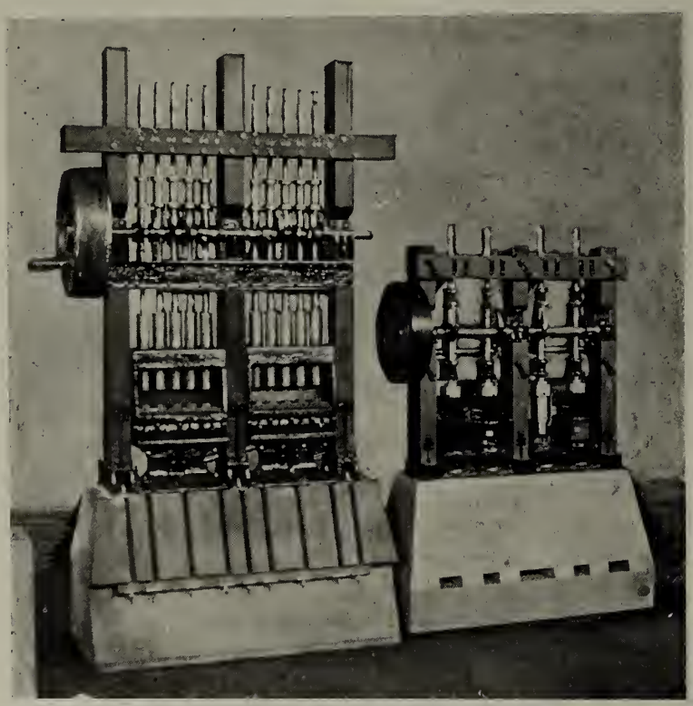
The banket ore being of low average value, the commercial principle applicable to the case is obviously that which enunciates the necessity of a large "turnover," and upon the metallurgical side of gold-winning operations more, perhaps, than on their mining side, the effort to give effect to this principle is constantly and everywhere in evidence. On the one hand, the maximum of plant capacity with the minimum of capital expenditure is the object aimed at; while on the other, the increase of profit by the lowering of working cost, if only by small increments, is considered well worth



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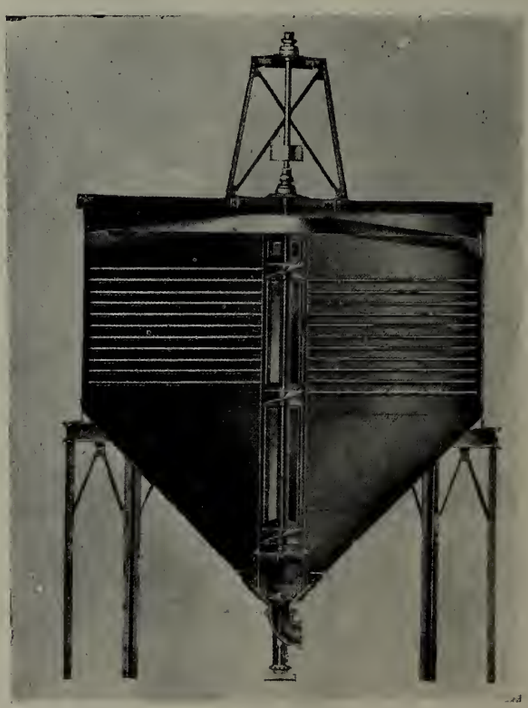
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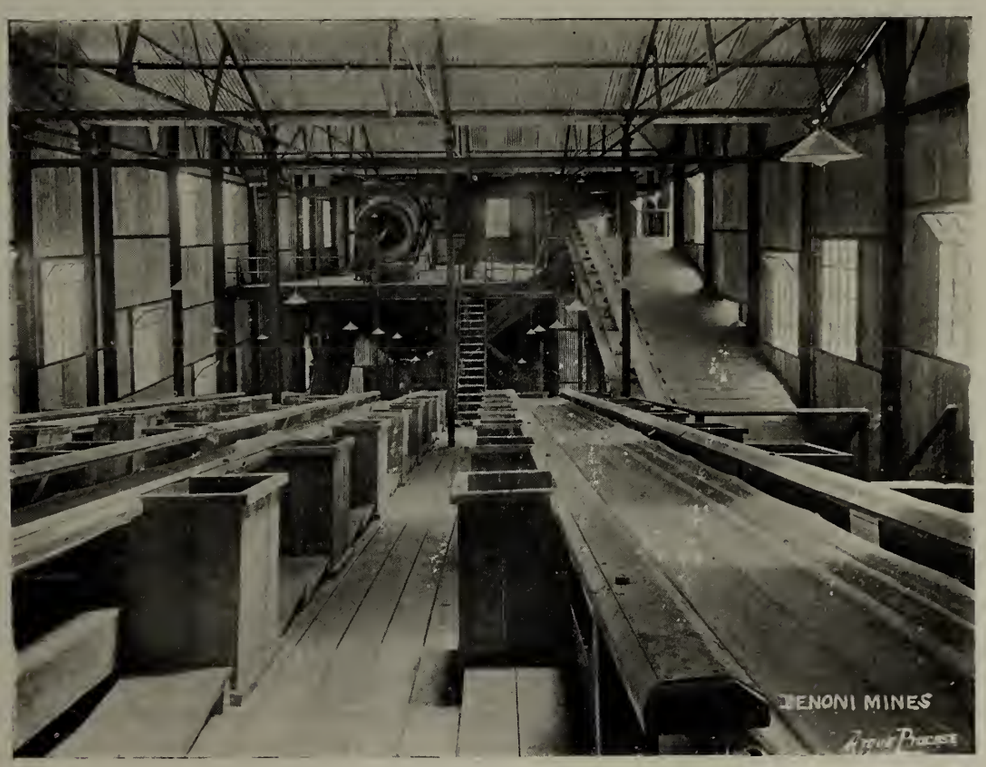
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striving for. In these circumstances, the utility of efficient mechanical appliances of various kinds and the advantage of large treatment units are easily apparent, and in one way or another the practical recognition of these facts will be perceived in all the methods and operations now briefly to be described.

Preliminary Sizing.

The ore which is sent to the surface from the mine is usually separated at the shaft head into two portions, known as "fines" and "coarse rock." The operation is rapidly and roughly performed by means of a "grizzly," the bars of which are spaced about $1\frac{3}{4}$ inches apart. The "fines" are commonly sent directly to the battery, for, although a large percentage of this material may be "waste" rock, which has become unavoidably mixed with the ore in the process of mining, it would be impracticable to sort it, as is done with the coarser rock. It is considered that the "fines," or under two-inch product, may be taken at from 35 per cent. to 50 per cent. of the total rock hoisted, and that of this quantity some 17.5 per cent. to 25 per cent. consists of fragments of less than $\frac{3}{8}$ inch diameter (C. O. Schmitt). The "coarse" and "fines" are ordinarily collected in bins at the shaft head, whence they are fed to trucks, wagons, or conveyor belts for delivery to those points where the succeeding operations begin. In some instances the rock from the mines is sent to the sorting plant before the preliminary sizing is made, the "fines" going, as before, to the battery, and the "coarse" to the sorting belts or tables.



Sizing Trommel, Sorting Belts and Waste Shoots, Renoni Mine.

Sorting.

The practice of sorting, of which the merits and demerits were largely argued about in the early days when the process was being introduced, is now universally in vogue on the Rand, to a greater or less degree. It is clear that, although the mining of waste rock with "reef" is always unavoidable and frequently necessary, it would be altogether bad economy to incur such additional expenditure upon it as would be involved in crushing and further treatment, and to run the risk of losing gold owing to the undue dilution of payable by unpayable ore. The problem is one that may be worked out very simply, and consists in finding out whether or not the increased gold value of a ton of clean ore is outbalanced by the cost of mining and sorting the waste rock, plus the loss of such small quantity of gold as is commonly contained in the rock thrown away. These costs must, of course, be borne by the gold recovered from the clean ore, while the gold lost in the rock thrown away would otherwise pay some portion of the expenditure incurred in recovering it.

The following examples by H. S. Denny ("Metallurgical Practice on the Witwatersrand") will sufficiently indicate the general nature of the problem. The cases quoted are those of a mine with, say, one hundred stamps, where only five hundred tons of ore can be dealt with per day. If 25 per cent. of the mine product is sorted, only seventy-five stamps can be run, whereas without sorting the full mill could be kept running. Assume that the ore consists of 50 per cent. coarse rock and 50 per cent. fine, and is worth, delivered at surface, 14 dwts., that 80 per cent. recovery can be obtained in either case, and that the waste rock discarded in the case of sorting is worth 2 dwts. The figures relating to working costs and recovery are not altogether in agreement with present day conditions, but, generally, the cases taken are sufficiently representative of the various factors involved.

I.

One hundred stamps will crush 500 tons of ore per day.

250 tons fines at 14 dwts.	3,500	dwts.
125 ,, sorted ore at 26 dwts. ...	3,250	,,
375 tons of ore at 18 dwts.	6,750	dwts.

80 per cent. recovery of 18 dwts. = 14.4 dwts. = 60.48s.

Expenditure per ton milled (375 tons).

	s.	d.	£	s.	d.
Mining	14	0	262	10	0
Crushing		6	9	7	6
Sorting		6	9	7	6
Milling	2	6	46	17	6
Cyaniding	2	6	46	17	6
Slimes treatment		6	9	7	6
General charges	3	6	65	12	6
Head office	2	0	37	10	0
Development redemption ...	4	0	75	0	0
	30	0	£562	10	0

Profit, 60.48s. – 30s. per ton = 30.48s. per ton = £571 10s.

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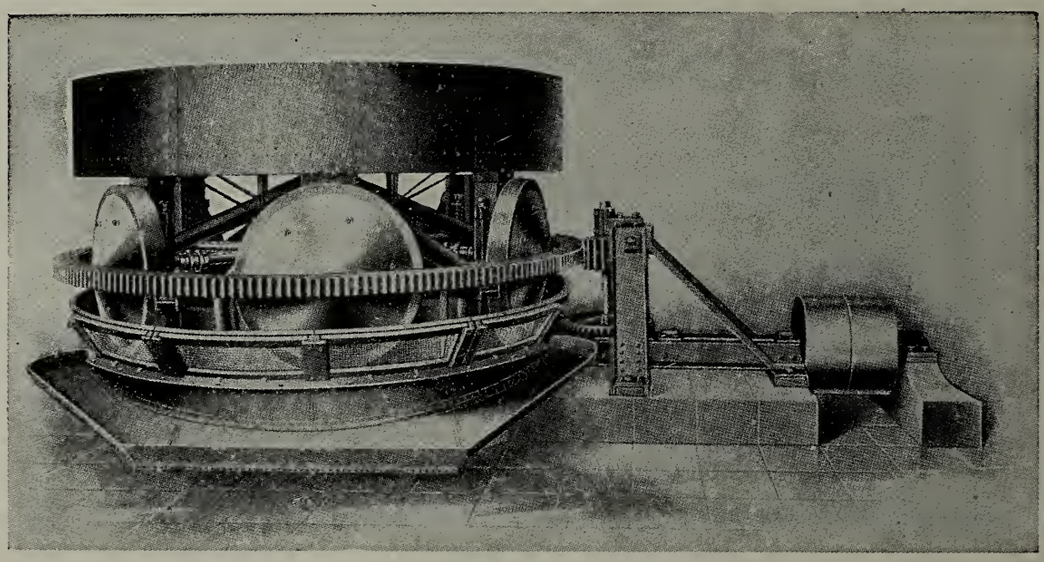
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II.

Five hundred tons at 14 dwts. = 7,000 dwts. Eighty per cent. recovery of 14 dwts. = 11.2 dwts. = 47.04s.

Expenditure per ton milled (500 tons).

	s.	d.	£	s.	d.
Mining	10	6	262	10	0
Crushing		6	12	10	0
Milling	2	6	62	10	0
Cyaniding	2	6	62	10	0
Slimes treatment		6	12	10	0
General charges	3	0	75	0	0
Head office	1	6	37	10	0
Development redemption ...	3	0	75	0	0
	24	0	£600	0	0

Profit, 47.04s. − 24s. = 23.04s. per ton = £576.

There is thus a difference in favour of II. to the extent of £4 10s.

In the latter case, however, there is an extra charge for loss of water used and for depreciation of the extra stamps to be run, and, if these allowances are made, there is in the comparison above made very little difference.

The whole issue, remarks Mr. Denny, hinges finally on the value of the rock discarded. If that value is only one pennyweight, then sorting will prove advantageous, but if we allow three pennyweights for the waste rock, then it would not pay to keep the extra mills idle, and it is by the determination of this factor that the policy to be adopted must be guided.

In the expenditure of table I. the three items of mining, general charges, and mine development redemption will be observed to be higher than in II. by reason of the fact that the total cost under these headings is distributed over a smaller tonnage of gold-yielding ore, and there is, in addition, the cost for sorting.

In earlier days, when sorting was first practiced upon the Rand, revolving tables driven on rollers by means of spur gearing were usually employed, the native pickers standing within the inner circumference. The waste was thrown through shoots into hoppers, whence it was trammed to the waste-rock dump, while the clean ore, having been swept from the table near the end of a complete revolution by means of a plough, was fed to the rock breakers preparatory to being conveyed to the mill for final crushing. In modern plants the use of rubber conveyor-belts has largely come into vogue for various purposes, and instead of the old circular tables a series of wide belts provide the sorting surface required. The following description of the sorting plant at the New Kleinfontein mine will serve to explain the arrangements adopted at one of the modern mills :—



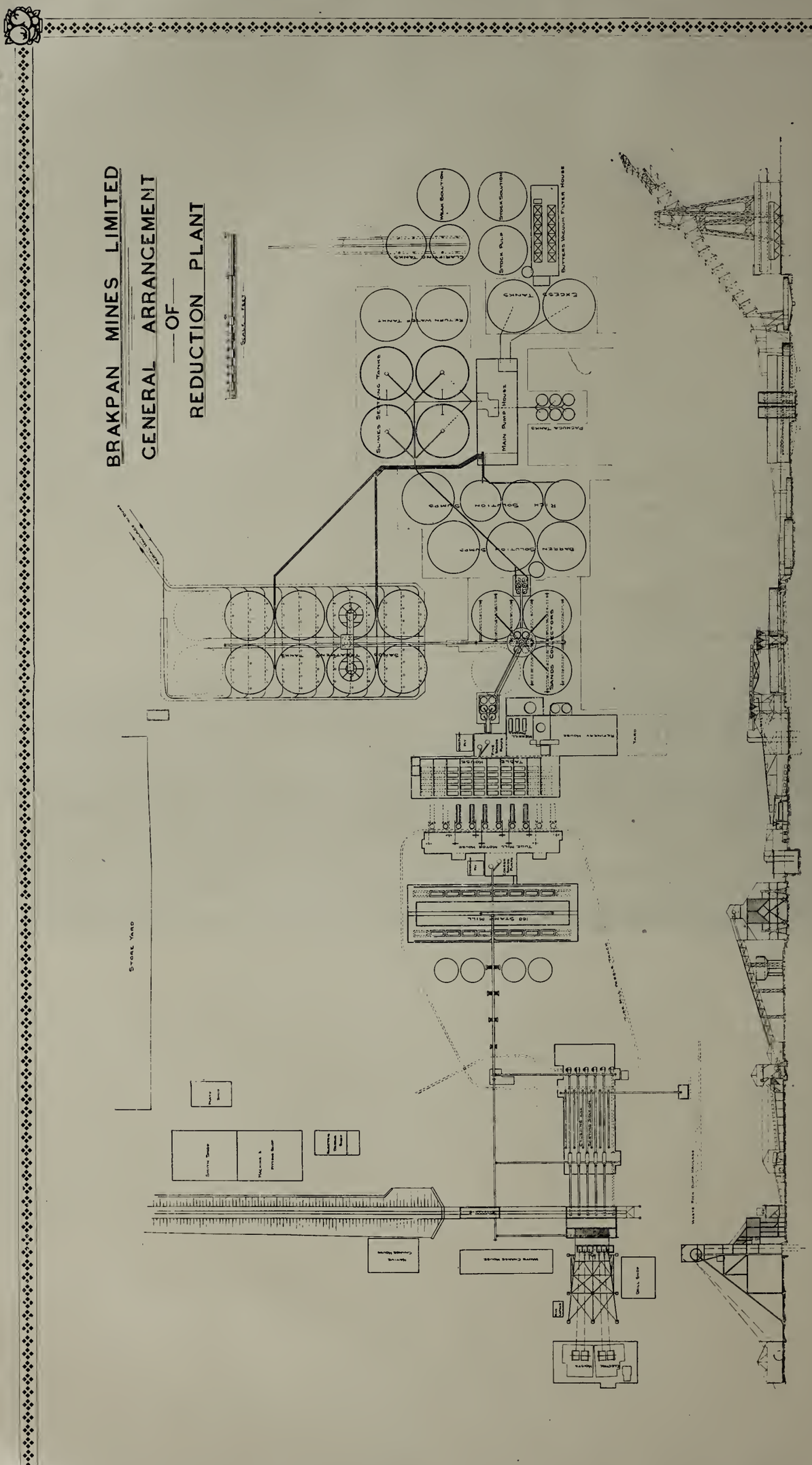
Shaft and Sorting House, Modder B.

Crusher-Station.—The rock carried from the headgear ore-bins by a conveyer is discharged on to a shoot and delivered directly to the main trommel, where it is subjected to a double process, the upper section of the trommel acting as a screen to remove "fines," and the lower section acting as a washer, freeing the "coarse" rock from dust and dirt and so facilitating sorting. Water supplied by a 4-inch perforated pipe, and distributed evenly over the rock on its passage through the lower section of the trommel, drains through the perforated plate, is caught by a collecting-box fixed immediately below the trommel, and is then led by a branch launder to the main launder running outside the building and carrying the washings from the "return intermediates" trommel, as well as from the main trommel just described, to two settling tanks situated outside the crusher-station. The screening section of the trommel removes 40 per cent. of the total quantity of rock passing through it, which falls as "fines" directly into a bin having a storage capacity of 450 tons, situated immediately below the trommel and known as the No. 1 "fines" bin. The remaining 60 per cent. or "coarse" rock, on issuing from the trommel, passes first over a "dripper" or short grating built of 1-inch square bars on edge, spaced 1½ inch apart, centre to centre, and then falls directly on to the main grizzleys, formed of manganese steel bars 1 inch by 4 inches by 14 feet in length, spaced 3½ inches apart, centre to centre. The rock passing over the grizzleys is sorted into two sizes, all less than 2½-inch cubes, an average of about 40 per cent. passing between the bars and falling into the two "intermediates" bins, whilst the remainder passes on into the two "coarse" bins. These four bins have no storage capacity and simply act as feeder-bins for the picking-belts.

A platform inclined at an angle of 16° runs from directly below the "coarse" and "intermediates" bins up to the sorting-floor, which is carried by the waste-rock bin-caps and slopes upwards at an inclination of 10° from this platform to the sorting-belts platform, situated above the crusher-platform. The sorting-floor carries four sorting-belts, two for "coarse" and two for "intermediates," and provides on both sides of each belt nine openings leading directly to the waste-rock bins, and floor-space for two boys to each opening; provision has thus been made for thirty-six boys to work on each belt, or a total of 144 boys on the sorting floor. The "coarse" and "intermediates" sorting-conveyors, proceed at an inclination of 16° from the "coarse" and "intermediates" bins up to the sorting-floor, and at an angle of 10° over this floor up to their head ends on the sorting-belts platform. The "coarse" belts, 36 inches in width and 86 feet 6 inches in length between the pulley-centres, driven by 10-H.P. motors, travel at a speed of 50 feet per minute and have a capacity of 58 tons per hour; whilst the "intermediates" belts are 36 inches in width and 98 feet 5 inches in length between the pulley-centres, and, driven at a speed of 50 feet per minute by 10-H.P. motors, carry 61 tons of rock per hour. These speeds can be either increased or diminished 20 per cent.

The "coarse" rock, falling from the main grizzleys into the "coarse" bins, is fed by shoots and regulating-doors at a constant rate on to the "coarse" conveyors, where it passes through the first stage of sorting, after which the remaining rock is discharged at the head ends of the belts on to shoots leading it directly to the two 30-inch by 18-inch "coarse" crushers, of the Blake Marsden eccentrie-motion type, to be broken into 3-inch cubes.

The crushed rock falls on to grizzley-bars spaced 1 inch apart and is separated into two sizes; all rock smaller than 1 inch cubes, about 5 per cent. of the total, falling between the bars as "fines" into the No. 2 "fines" bin, and the rest passing on as "return intermediates" to the "return intermediates" bin. This bin acts merely as a feeder-bin for the "return intermediates" conveyor, and is fitted with a shoot and regulating-door for feeding the rock at a constant rate on to the belt. This conveyer runs upwards between the waste-rock bins at an angle of 21°—which is found to be about the limit of inclination for rock of this size—and extends from the "return intermediates" bin to the "return intermediates" trommel. The belt is 18 inches in width and 79 feet 2 inches in length between pulley-centres, and when travelling at a speed of 300 feet per minute, has a capacity of 50 tons per hour. The "return intermediates" trommel, inclined at an angle is carried on a platform just above the "intermediates" bins, and acts simply as a washer, cleaning the "return intermediates" from dust and dirt previous to undergoing a second sorting on the

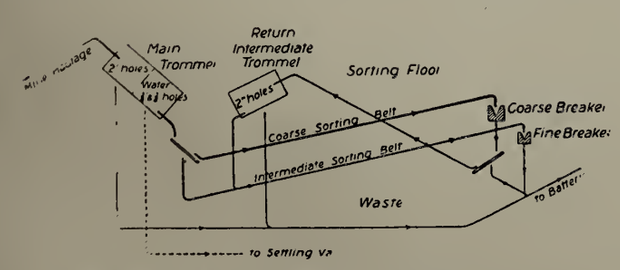

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Mill Office
Mill Store
Mill Office
Mill Store

"intermediates" sorting belts. The rock falling from the mouth of the "return intermediates" trommel joins the intermediates," separated by the main grizzleys from the rock discharged by the main trommel, in the two "intermediates" bins, and is fed, together with the "intermediates," by means of shoots and regulating-doors, at a constant rate, on to the "intermediates" sorting-belts, where it is sorted in conjunction with the "intermediates," after which the remaining rock is discharged at the head ends of the belts, on to shoots leading direct to the "intermediates," crushers.

The main trommel, as previously mentioned, delivers, as "coarse" and "intermediates," about 60 per cent. of the total rock brought to it by conveyor from the headgear bins at the central shaft, to the sorting-belts, where, during the sorting, as already described, about 50 per cent. is removed as waste, amounting to about 30 per cent of the total rock brought to the surface from the mine. The ore from the "intermediates" sorting-belts is fed by means of a system of shoots to three "intermediates" crushers. The "intermediates" are here broken into 1-inch cubes and fall as "fines" directly into the No. 2 "fines" bin. This bin, having a storage-capacity of 750 tons, brings the "fines" storage-capacity of the crusher-station up to a total of 1,200 tons. The two waste-rock bins, situated immediately below the sorting-floor and separated from each other by the platform supporting the "return intermediates" belt, have a total storage-capacity of 1,500 tons, and are each fitted with three shoots designed for feeding the waste-rock at any desired rate on to the waste-rock belt-conveyor, and with a large baffle-plate to prevent rock being dropped from the sorting-floor through the shoots directly on to the belt. Similar shoots have been fitted in the two "fines" bins, two in the No. 1 bin and three in the No. 2 bin, and feed the "fines" at any desired rate on to the "fines" conveyor to the mill.

Waste-Rock Belt.—This conveyor runs horizontally below the waste-rock bins and carries the waste-rock from these bins to deliver it through a shoot on to a second conveyor. This latter belt, the first section of the main waste conveyor, runs at right-angles to and below the head end of the first. The waste-rock belt, 30 inches in width and 52 feet 6 inches in length between pulley-centres, travels at a speed of 200 feet per minute, and has a carrying-capacity of 112 tons per hour.

"Fines" Conveyor from Crusher-Station to Mill.—The "fines" conveyor runs under the crusher-station along its entire length, and after running below the two settling-tanks previously referred to, proceeds upwards at an angle of 18° to its head end. The belt is 24 inches in width and 365 feet in length between pulley-centres, and, travelling at a speed of 350 feet per minute, raises the "fines" through a vertical height of 58 feet and transports a maximum of 168 tons per hour from the "fines" bins to the conveyor feeding the mill-bins.



Breaking and Sorting Plant, New Kleinfontein Co., Ltd.

The accompanying diagram illustrates the cycle of operations referred to above. At Brakpan, where one of the most modern and best-arranged reduction works has lately been erected, the arrangement is as follows:

Sorting and Crusher Station. The skips discharge on to 1½-inch grizzlies, the fines passing to a bin which discharges direct on to a cross-belt delivering to the main incline mill belt. The coarse bin discharges on to five belts, which convey the rock to washing trommels. From the trommels the ore is delivered on to five sorting belts, which in turn discharge into five reciprocating Giescke crushers, thence passing by means of a cross-belt to the main incline belt to the mill. The waste rock sorted out is deposited on six waste-conveyors, which are located between the sorting-belts. The sorting station is well lighted by means of skylights. The crushers are 31½ inches by 13¾ inches, and are driven independently by 50 h.p. motors. An exhaust fan is connected to a duct having adjustable inlets fitted to the base of each crusher, and delivers to a dust chamber outside the building. The waste is delivered to a cross-belt, which discharges into a bin, from whence it is taken by an endless rope haulage to the dump. At the head of the sorting belts reef pebbles are sorted out and conveyed in trucks to the tube mills. Each sorting belt is 32 inches wide, has a net sorting length of 72 feet, and, together with its adjoining waste belt, is driven by a 5 h.p. motor. The trommels and the five belts feeding them are driven by a 50 h.p. motor. Space is provided for a sixth unit, consisting of trommel, sorting belt, and crusher.

Main Incline Belt.—This belt is 32 inches wide, and is fed by two horizontal belts, one conveying the grizzlied and trommel fines, and the other the ore from the crushers. The mill belt, running at an angle of 18 degrees, delivers at right angles on to a 32-inch shuttle belt over the mill bins, the capacity of which is 6,000 tons.

The arrangement is shown in the accompanying plan and elevation.

While the conditions under which the banket reefs occur make it impossible to mine the ore body without breaking down with it more or less of the valueless enclosing or "country" rock in any mine, the proportion of waste included in the tonnage sent from the stope naturally depends upon the thickness of the ore body and upon the ease or otherwise with which the clean reef may be broken from the enclosing walls. The auriferous beds are either separated from the hanging-wall or footwall, or both, by bedding planes, for instance, or are cemented to one or other, or to both, of these walls, and upon these physical characteristics, therefore, depends the waste rock blasted down and also the width of the stope. Sometimes the reef is wide or, at any rate, of convenient working width, or it may consist of two or more separate beds divided by a greater or less thickness of barren rock, all of which it may be convenient or necessary to mine over a single face. At other times the reef is narrow, sometimes consisting of a mere line of pebbles or a still narrower seam of auriferous material. The average width of the one payable reef in the Roodepoort area is scarcely more than five inches. In the Ferreira, the width of the



General View, New Kleinfontein.

South Reef varies from one and a half to two and a half feet, and the width of the payable Main Reef leader from about six inches to one and a half feet. In the lower levels of the Meyer and Charlton the width of the Main Reef leader is, on the other hand, about six inches, while that of the South Reef varies from two and a half to five feet. In the Rose Deep, the North Reef varies from a few inches up to eight feet. It is usually separated by a quartzite parting, one to two feet thick, from the overlying Middle Reef, and it is there found convenient to mine these two together in a single stope of about eight feet in width. At the old Jubilee mine, twenty-feet stopes were worked, in which the Main Reef leader and Main Reef were carried, the operation being performed by means of an advance four-foot overhand stope on the Main Reef leader, followed by quarrying the remaining sixteen feet of reef. It is obvious that at each of these mines the quantity of waste, of necessity, varies considerably, and so on with every mine on the Rand. The variability is shown clearly in the monthly analysis which is published by the Transvaal Chamber of Mines, and a comparison of the individual averages quoted month by month provides occasionally some indication of the quality of the ore sent to the mill from time to time.

Before concluding these remarks upon sorting, it may be as well to point out that it is impossible to pick out, roughly speaking, more than about fifty per cent. of waste sent from the average Rand stope. G. A. Denny, in his paper on "Metallurgical Practice on the Witwatersrand," read before the Chemical, Metallurgical, and Mining Society of South Africa in 1903, said:—

"If machines are used exclusively for stoping, the percentage of fines will be high; whilst, if hand labour only is used, the percentage will be low. On many mines a combination of the two is resorted to. Thirty per cent., however, represents about the minimum and sixty per cent. the maximum, and something between the two, say forty to fifty per cent., will be the average." It is necessary to bear this in mind when considering the value of ore reserves as declared in the annual reports of some companies. The reserve tonnage in the cases referred to is given as "stoping tons"—that is to say, the tonnage is calculated over the average width which is found by experience to be required for working purposes or to result from working operations. In proportion as this width is greater than that of the ore body, so is the quantity of waste rock included in the ore reserve as published. The declared value of this tonnage will be increased in the subsequent sorting process, and the "milling tons" resulting therefrom will be, of couse, fewer in number but higher in grade than the tons estimated to be in reserve. Other companies declare their reserve ore as "milling tons," and by this is to be understood the tonnage that it is estimated will be sent to the mill bins from the sorting plant. A company that ties itself down to estimates of this latter kind lays itself open to be checked month by month as the recovery per ton milled is declared; a company that gives the other view of things does not. Cleaner mining or variation in the sorting average from shortage of labour or other reasons may be the explanation of varying grade, although the former is limited by the fact that absolutely clean mining is an impossibility if the whole reef body is taken out.

Stamp Milling.

After being sorted, the coarse rock is put through ore breakers for further reduction before being sent to the stamp mill. The ore breakers in use are of two types, the "Blake," or swinging-jaw breaker, and the "Gates," a gyratory machine. Each type has its supporters, but the latter is usually preferred when large unit capacity is demanded, while the former is favoured where several machines are suitable to the general lay-out of the sorting and breaking plant. Thus, where several sorting belts are installed, as in large modern plants, each delivers to its own breaker or set of breakers. At the Crown Mines, for example, each sorting belt supplies three Blake machines, which are grouped around the delivery end of the belt, directly over a concrete ore-bin. Where the mill is located at no great distance from the sorting station, the sorted ore, broken to pass, say, a two-inch grizzly, is conveyed to the ore-bins in the battery house by a belt upon which the fines have already been deposited. There the whole is fed to a second conveyor belt, which runs over the full length of the mill bins, and discharges the ore at any desired spot by means of an automatic travelling "tripper" with double discharge, which runs upon a track over the bins. Where a considerable distance has to be covered between the sorting station and the mill, transport is effected by ordinary mine trucks or by railway wagons with a capacity of about forty tons. In these cases, also, delivery is usually made directly to the ore bins. It is interesting to note the "grading" of the



Modern type of Long Stamp Head and open fronted Mortar Box, Brakpan Mines.

material spoken of as "fines," that portion of the ore from the mine, namely, which, according to arrangements commonly in vogue on the Rand, does not pass through the sorting station. In his paper on "Future Economies in Rand Reduction Plants," C. O. Schmitt says: "The rock brought from below ground contains a considerable amount of fine particles, which are now generally eliminated by screening the total rock into a +2-inch and a −2-inch product. The latter product, however, also contains a good deal of $-\frac{3}{8}$ inch; and the gradings obtained by the author from two mines showed the following result:—

		Mine A, per cent.		Mine B, per cent.	
$+\frac{3}{8}$ in.	...	58·3		45·38	
$-\frac{3}{8}+90$	...	38·3	41·7	46·92	54·62
−90	...	3·4		7·7	

In view of these figures, Schmitt is of opinion that some portion of the so-called fines, the $+\frac{3}{8}$-inch material, might be subjected to further sorting; the $-\frac{3}{8}+90$ (mesh) should be sent directly to the tube mills; and the −90 (mesh) to the cyanide plant; leaving only the $+\frac{3}{8}$ to be crushed by the stamp battery.



Heavy Stamp Battery with Amalgamating Plates, West Rand Consolidated.

During recent years, particularly since the introduction of the tube mill for fine grinding purposes, the tendency has been to increase the weight of stamps, and whereas the weight just after the war period ranged from 850 to 1,350 lbs. per stamp, all later mills have been equipped with stamps of a weight ranging from 1,550 to 2,000 lbs. "The main object to be attained in stamp milling at the present day," according to the late G. O. Smart, "is not so much to obtain the maximum extraction of gold from the ore on the mill plates, as was the case when battery amalgamation was the only recovery process relied upon in the treatment of gold-bearing ores, but rather to run the stamps in such a manner that the most profitable results shall accrue from the whole process of treatment in the reduction works—that is, from the time the ore is deposited in the mill bins until the time it is discharged as sand or slime residues. This usually means that a high stamp duty has to be maintained in order that the maximum tonnage shall be reduced to a degree of fineness commensurate with the capacity of the tube mill plant, which regrinds the coarser particles in the mill tailing." In a word, the employment of tube mills for fine grinding, a process which many metallurgists and engineers maintain to be outside the economical range of the stamp mill, has made it possible to use the latter very largely as a coarse rock breaker. Experiments made for the purpose of ascertaining the most useful division of work between stamps and tube mills, and the maximum sized particle of ore which could be efficiently pulverised in the usual tube mill of five and a half by twenty-two feet, led to the discovery that a nine-mesh to the square inch (aperture 0.272 inch) gave the best results. Since then, even a larger mesh has been tried, and at the Princess Estate mill a four-mesh screen is being used with success. Obviously, the wear and tear of the coarse product from such screens could not be resisted by the ordinary amalgamated copper plates over which the four hundred and six hundred-mesh pulp of earlier days flowed without inconvenience. The augmenting of stamp weights and widening of screen meshes, therefore, has been followed, in modern plants, by the removal of the old-time amalgamating plates from the battery to the tube-mill house, and the deferring of the first step in gold recovery, that of amalgamation, to the period immediately following that of final grinding. Various advantages result from this procedure, not the least among them being the complete separation of the purely mechanical operations of crushing and grinding from those more important and delicate ones of collecting and handling gold.

The question of the relative efficiency of the stamp plus tube-mill combination and that of the stamp alone, or, as it is commonly termed, the double and single-stage crushing problem, has for long been a somewhat warmly contested one between two groups of engineering thought upon the Rand, and probably also elsewhere. There are, unfortunately, no sufficiently satisfactory data available as yet by means of which a definite conclusion can be arrived at upon one side or the other, for while, from the working cost point of view, a better

showing seems to be made by single-stage crushing mines, theoretical considerations and capital expenditure estimates presented by the supporters of double-stage crushing are equally striking. The conditions which prevail at different mines where the alternative methods are in vogue are sufficiently diverse to justify an undecided attitude on the part of the unbiassed onlooker until such time as more reliable comparisons can be made. As far as actual influence goes, however, that of the stamp plus tube-mill school is, for the present at any rate, altogether in the ascendant, and tube mills form an essential feature in every modern Rand equipment.

The older type of mill is still largely in evidence, nevertheless, in which stamps of what may be regarded as a moderate weight, fine screens, and full-sized amalgamated plates immediately in front of the mortar boxes are, as hitherto, the usual features. Tube mills, where added to the equipment in these instances, are employed to increase the crushing capacity of the mill and increase the fineness of the product within much the same limits as those assigned to the more recent combinations. The ratio of tube mills to stamps, as shown in the monthly output analysis of the Transvaal Chamber of Mines, and the corresponding stamp duty, shows how much variation there is between one mill and another, and, again, between the older and newer type of mill, as regards the extent to which crushing capacity is extended by the addition of tube mills and coarse screening.

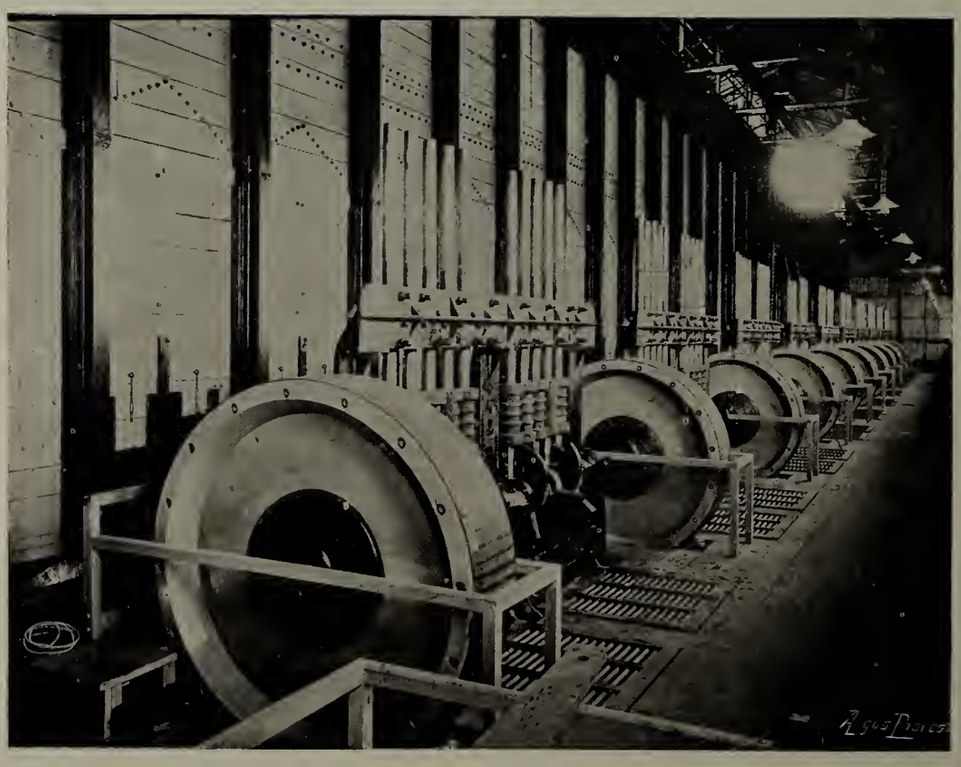
The following is taken from a description of the New Kleinfontein mill, where single-stage crushing is almost entirely in vogue, by E. J. Way, consulting engineer to the company, and one of the foremost supporters of the single-stage operation. It will serve to illustrate the best features of that type of equipment :—

Stamp Mill.—The stamp-mill will be best described by following the course of the ore from the time it is delivered as "fines" by conveyor to the mill-bins until it leaves the mill as "tailings" by the main launder to the tailings-wheel.

The "fines" deposited in the storage-bins of the crusher-station are fed by the bin shoots on to conveyors, and, after passing through a weighing-room, they are distributed equally along the full length of the mill ore-bins by means of an automatic tripper. In the weighing room a 30 feet length of the belt is supported by a Blake Denison weighing-machine, and the weight of the "fines" passing into the mill is automatically registered. Within the mill the conveyor is fitted with an automatic travelling tripper, with double discharge, arranged to run above the ore-bins over a track, 164 feet in length. This belt, 20 inches in width and 220 feet in length between pulley-centres, runs at a speed of 400 feet per minute and has a carrying capacity of 168 tons per hour. A 1½-inch hose-pipe is clamped to the tripper, its nozzle being directed so that a stream of water plays on the upper surface of the belt just after it has passed round the head pulley of the tripper. A collecting-box, fitted to the tripper, catches the washings from the belt and delivers them to a launder, and thence to the two settling-tanks previously referred to under the crusher-station. The mill ore-bins measure, inside the lagging, 162 feet 3 inches in length by 24 feet 1¼ inch in width, with an average depth of 16 feet from the underside of the bin-caps. They are divided into two compartments by a longitudinal partition of 3-inch by 9-inch deals, supported on each side at intervals of about 6 feet by posts 6 inches by 9 inches, and have a maximum storage-capacity of about 3,200 tons, or rather more than 2½ days' supply for the stamps.

Owing to the spacing of the belt-drives, the stamps have been arranged differently on the two sides of the mill, being divided on the east side into five batteries of twenty heads each, and on the west side into four batteries of twenty heads each, with two end batteries of ten heads each. The twenty-stamp batteries have centre king-posts 24 inches by 24 inches in cross-section, and intermediate and end king-posts 15 inches by 24 inches, whilst the ten-stamp batteries have centre and end king-posts 15 inches by 24 inches. There is 5 feet 9 inches clear space between the end king-posts of adjacent batteries, and 15 feet 9½ inches between the end framing of the mill next the engine-room and the end king-posts of the first batteries. The mill main-line shafting, ranging in diameter from 10 inches in the engine-room to 5 inches in the amalgamating-room, runs down the centre of the mill, supported by ring-oiling bearings provided with means for both vertical and lateral adjustment, and bolted to sole-plates checked into and bolted to the strake-sills. The belt-pulleys, of cast-iron, 46 inches in diameter by 17 inches in width of face, run loose on the line shafting, and are fitted with Seymour friction-clutches keyed to the shaft, and designed to transmit 50 h.p. when running at 70 revolutions per minute; these clutches are operated by hand-wheels mounted on standards on a platform carried by joists housed into and screwed to the main struts under the bins. The cam-shaft pulleys, 70 inches in diameter by 17 inches in width of face, built up of clear pine boards spiked and glued together, are driven by seven-ply red rubber belting, 16 inches in width, manufactured by the Manhattan Rubber Company, and are arranged with as flat a drive as possible, in order to do away with the necessity of belt-tightening gear. The cam-shafts run at 46 revolutions per minute, giving 92 drops per head per minute, and have each ten Blanton cams fitted to the shaft. The stems of the stamps are 16 feet in length by 3¾ inches in diameter, the heads are 24 inches by 9 inches, the shoes 12 inches by 9 inches, the dies 6 inches by 9 inches, and the tappets 13 inches by 9 inches, arranged and fixed in position for a 7-inch drop, The weights are: stem 592 lbs.; head, 380 lbs.; shoe, 237 lbs., and tappet, 147 lbs.; giving a total falling weight of 1,356 lbs., or, if 14-inch shoes are used, 1,400 lbs. The falling weight of the stamps, the height of drop, and the number of falls per minute, have all been calculated with the object of giving the stamps a minimum output of 5.5 tons of ore per head per 24 hours, crushed through wire screening of 1,000 meshes to the square inch, or a total output for the mill of 1,100 tons per day of 24 hours. The mortar-boxes, with

RAND MINING IN PICTURE



Cam Shaft Floor and Ore Bins, City Deep

the exception of two which are of the Morrison open-front type, are all of the Homestake pattern, weighing approximately 5 tons each, and stand on ¼-inch rubber sheeting on the top of piles to which they are securely bolted down. The piles are built up of eight pitch-pine blocks 15 inches by 15 inches by 12 feet 9 inches in length. They rest, at the bottom of the pile-pits, on a solid foundation of concrete, and are grouted in with concrete to the level of the under-side of the mud-sills. The boxes are lined with manganese-steel plates bolted to the casting, have false bottoms 2½ inches in thickness, and are fitted on top with cover boards 1½ inch in thickness, and in front with screen-frames covered with wire-screening of 1,000 meshes to the square inch. Each box also has a metal lip bolted to it at the back to act as a shoot, and to receive the ore delivered to the box by the ore-feeder. Behind each box the mill ore-bin is fitted with a regulating sliding-door and a shoot, delivering the ore from the bin to the hopper of the feeder. The feed-motion is obtained by a buffer-lever operated by a tappet fixed below the bottom guide-blocks on the centre stem of each five heads of stamps.

The water-service to the batteries is designed to give to each mortar-box a maximum of 10 tons of water per ton of ore stamped.

The tables, forty in number, one to each mortar-box, are firmly bolted down to the table floors; are covered with amalgamated copper plates 14 feet 10¾ inches in length, 4 feet 11 inches in width, and ⅛ inch in thickness; and have a fall of 1 in 12 to transverse launders at the bottom of the tables. The crushed ore, passing through the wire screens in front of the mortar-boxes, falls upon the copper plates and runs over them in an even stream, to be caught by the transverse launders above-mentioned, and led by short launders with a fall of 1 in 12 to the mercury traps. These traps are of cast-iron in one piece, with a circumferential launder provided with a discharge-lip round the upper edge, and with an opening at the bottom, fitted with a screw-plug. Any free mercury passing over the plates, collects, owing to its greater specific gravity, at the bottom of the traps, and is drawn off from time to time as required through the openings mentioned above, whilst the sands and water flowing over the upper edge are caught by the circumferential launders, and carried by short launders with a fall of 1 in 12 to the two 12-inch by 9-inch main launders. Each table-floor has a fall of 1 in 12 to a launder, provided for the purpose of catching the washings when the floor is cleaned down, running below the whole length of the free edge of the floor, which discharges the washings into short branch-launders running with a fall of 1 in 12 to the two main launders. These launders have a fall of 3.5 per cent. and run, outside the mill, one on each side, the full length of the building, the one on the east side having to turn at right-angles on reaching the end of the mill, and pass below the floor of the amalgamating-room in order to unite, at the south-west corner of the mill, with the launder running down the west side of the building, and form the 18-inch by 9-inch main launder carrying the tailings to the tailings-wheel. These launders are fitted with a false bottom of pitch-pine, 1 inch in thickness, pierced with 1½-inch circular holes, spaced zig-zag at intervals of 2 feet, provided for the purpose of catching any mercury that may have escaped the mercury-traps.



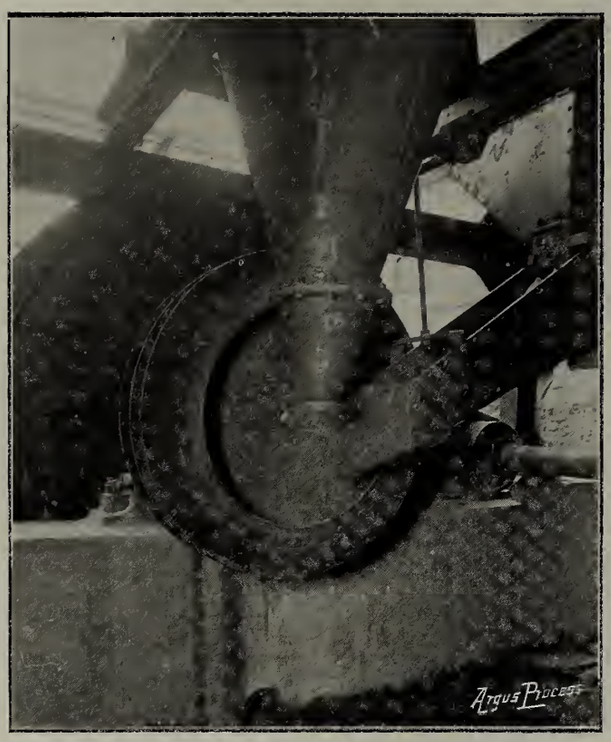
Randfontein Central, Tube Mill House.

Tube Milling.

The necessity of fine crushing in order to obtain the most complete extraction possible from the banket ore was recognised in early days. Since the war, however, in the more exhaustive investigations that have been made with regard to economy and efficiency in metallurgical work, the importance of fine grinding, particularly in connection with the hard ore from the deeper levels, has been abundantly demonstrated. The success of the tube mill in Western Australia, and the benefits derived from fine grinding there generally, led to practical steps being taken to adopt a similar process on the Rand. The value of the tube mill for the purposes required was pointed out by Mr. H. S. Denny in a lengthy paper read by him before the Chemical, Metallurgical, and Mining Society of South Africa in July, 1903, and to him, no doubt, is due the credit of having brought about its introduction to the Rand. The first tube mill working in circuit was that installed at the Glen Deep by Mr. J. R. Williams in 1904; since then the use of the machine has rapidly increased, the number running to-day being about two hundred and sixty.

A tube mill is a cylinder of sheet steel with cast-iron or steel ends, the size of which varies, a widely, or "standard," used type being twenty-two feet long by five feet six inches inside diameter, the capacity being equal to five hundred and twenty-three cubic feet. The ends are bolted to the shell, and two manholes are provided in the latter in order to give access for re-lining, repairs, etc. The trunnions are hollow to allow of ore and pebbles being fed into the machine at one end and discharged at the other. The mill is driven by spur gearing, the spur-wheel encircling the feed end and engaging with a driving pinion which is either driven from the line shaft of a mill engine or from separate electric motors. The inside is lined with renewable liners of silex, or flint, blocks, or of local stone from the dolomite formation of the Pretoria series. Other liners, such as bars of flat iron or steel, ribbed cast-iron segments, concrete blocks with protruding steel pins, etc., are also in use, the object of these devices being to form receptacles in which some of the pebbles may become fixed and so constitute a cheap and, to some extent, self-renewing liner. The life of liners is an important factor in the cost of running as well as in the degree of efficiency obtained from a tube mill. The pebbles, which are fed into the mills from time to time or automatically, as the case may be, average rather more than half a pound in weight, and W. R. Dowling estimates that the weight of a load of pebbles maintained at about three inches above the axis of such a "standard" machine is 12.8 tons. The weight of ore, in the form of sandy material, is, under the same circumstances, 4.5 tons. An exhaustive series of trials with the object of investigating the effect of different tonnages fed to tube mills, and the percentages of moisture in the feed, was carried out by the late G. O. Smart at the Simmer and Jack mine, and from these it was concluded that for Rand conditions and with a mill of the "Standard" type mentioned above, four hundred tons of sand, containing thirty-nine per cent. by weight of moisture, should be fed per twenty-four hours. A high degree of efficiency has doubtless been approximately arrived at on the Rand, but much remains to be learnt, by experimental means, with regard to the highest attainable efficiency in the matter of tube milling.

One of the first results of the use of these machines was the modification of the battery-screen mesh, in order that the work of crushing and grinding should be properly apportioned to the respective units. In August,



Schmitt's Tube Mill Feeder with Shoot for Pebbles, Robinson Deep.

1909, a trial was conducted at the Simmer East mill, under the auspices and at the expense of the Mines Trials Committee, when it was found that a nine-mesh screen (aperture 0.272 inch) gave the best results in combination with the "standard" tube mill. Since that date, the screen mesh of large aperture has come into general use where tube milling is adopted, as already mentioned, and a duty of as high as 20.03 tons per stamp per day is recorded at the Roodepoort United, the average for the Rand in June, 1912, being 8.33 tons.

The advantages of fine grinding, as shown in the residue or waste sand from the cyanide treatment vats, are thus briefly outlined by W. R. Dowling: "The values given are the average assays over an extended period of the sand residues discharged from the cyanide works after treatment. The classification is made in accordance with the percentages of 0.006-inch grade, which the samples contained. A., B., C., and D. represent different deep-level mines:—

Per cent. of ·006 inch grade.	Dwt. per ton.				Average dwt. per ton.
	A	B	C	D	
31 to 40	0·705	0·775	0·807		0·762
41 ,, 50	0·607	0·578	0·625		0·603
51 ,, 60	0·549	0·515	0·521		0·528
61 ,, 70	0·512	0·484		0·511	0·502
71 ,, 80	0·472	0·420		0·421	0·438

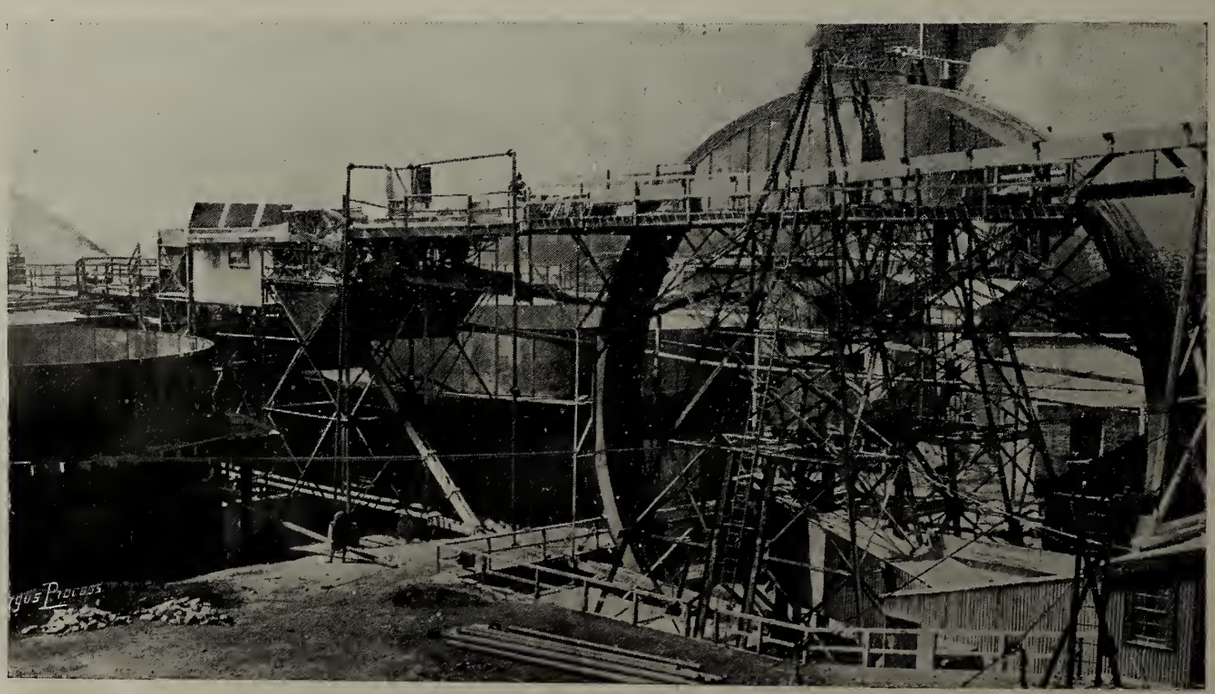
From the foregoing table it will be observed that the assay value of the residue decreases with the increased percentage of 0.006-inch grade, but that in the latter stages less additional gold is extracted per ten per cent. of additional 0.006-inch grade than in the earlier stages. Hence, whilst the difficulty and cost of fine crushing continually increase, the additional gold won thereby becomes less and less.

"The profitable degree of reduction of banket ore depends chiefly on the distribution of the gold in the ore. The quartz pebbles, constituting a large proportion of the ore, are in themselves free from gold, but, as they are embedded in the gold-bearing matrix, yield, on crushing, particles with adhering gold-bearing pyrite. The matrix itself, being mainly composed of silica, yields on crushing, grains of quartz enveloping particles of gold. It is this fact which makes separation of the gold by concentration into a pyritic product incomplete."

In a word, since the quartz pebbles of the banket are valueless, the object of metallurgists is to crush them as little as possible, the only portion of them which requires commination being the outer surface to which the pyritic cement of "matrix" adheres. The cementing material must be crushed in such stages and to such a degree of fineness as will effect the most complete recovery of the contained gold at the lowest cost.

The following general description of the progress of the coarse "pulp" from the stamp battery through what is known as "the tube-mill circuit" is taken from an admirable article from the same author in "A Text-Book of Rand Metallurgical Practice":—

"The tailing pulp leaving the stamp mill is elevated, usualiy by means of a wheel, but sometimes by a centrifugal pump, to a sufficient height for the final pulp to gravitate to the cyanide works and to allow of operating the tube-mill circuit. The pulp stream, after elevation, flows in a launder to classifiers, which are



Tailings Wheel Alevating Pulp to Classifiers, New Goch

pyramidal boxes or cones. The overflow of the classifiers, containing the finer particles of ore, passes on to the cyanide works, and the underflow drawn off at the apices of the classifiers is conveyed by means of a launder to other pyramidal boxes or cones. This underflow stream contains the larger and heavier particles of ore which require re-crushing. The classifiers, in addition to separating the relatively coarse and heavy particles from the fine, which overflow, reduce the water in the underflow pulp to about seventy per cent., the least amount of water necessary being determined largely by launder grade and amalgamation requirements. In general, the less the water in the underflow pulp the better, as there is less to re-elevate. The second set of pyramidal boxes which the stream now enters are used for the purpose of de-watering or thickening the pulp before it enters the tube mills, and one of these is placed at the feed end of each tube mill.

"During the passage of the underflow through the tube mill the larger particles are reduced by impact and abrasion of the falling pebbles. At the discharge end of the tube mill the outflowing stream is joined by the overflow of the dewatering classifier, which has been conveyed by launders for the purpose. The joint stream is distributed by launders to amalgamated shaking plates. During the passage of the pulp over the plates the amalgamable gold liberated in the tube mill is caught, and the stream flows back in a launder to the elevator, where it mixes with the tailing pulp from the stamp mill. The pulp entering the classifiers after elevation is, therefore, a mixture of fresh tailing pulp from the stamp mill and pulp returned from the tube mills. The foregoing process goes on continuously, the classifiers separating and delivering to the tube mills the coarse particles that have come from the stamp mill or have been returned from the tube mills. Hence no particle can overflow the classifiers until fine enough, as, whilst it still remains coarse, it simply travels round the tube-mill circuit. In recent practice, the classifying and dewatering cones above described are combined in a specially large cone for each tube mill."

The number and arrangement of cone classifiers in the tube-mill circuit varies somewhat in the latest plants; the chief object thus variously aimed at, as explained above, is the separating of the particles that require regrinding from those that may be sent to the cyanide plant as sufficiently ground, or unground sand free from pyrite, and the elimination of that proportion of the stamp-mill water as is not required in the tube-mill circuit. This hydraulic classification and dewatering process is simultaneously and admirably effected in the cones referred to, the types in common use being Caldecott's diaphragm cone and Stadler's classifier. The inflowing stream of pulp is led to the centre and below the surface of the water in the cones by means of a pipe of sufficient size, and the stream, deviated by means of a baffle plate, flows in all directions towards the periphery. As the circle of flow widens, the velocity of the current naturally diminishes, until, at the edge of the cone, it is just strong enough to carry off the lightest particles. The remainder sink towards the apex, and by proper adjustment of cone area, and capacity, and volume of inflowing stream the classification can be well regulated. The discharge from cones used as dewaterers averages generally about twenty-five to twenty-eight per cent. of moisture, and emerges as a steady-flowing, smooth-looking bar of thickened pulp.

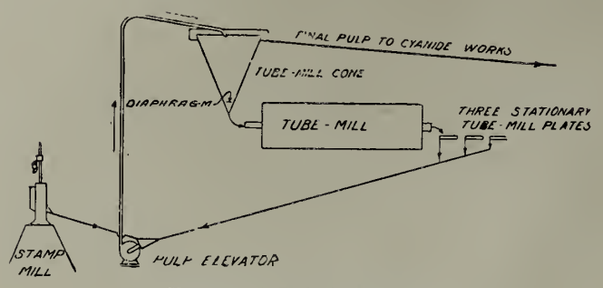
The following diagram, taken from a paper on "The Amalgamation of Banket Ore," by the author just quoted, gives an idea of a common arrangement of the tube-mill circuit. It may be mentioned, however, that the shaking amalgamating plates spoken of by him are latterly being abandoned in favour of stationary plates. The area of the plates has also been reduced in modern mills, as well as their number. Whereas the plate area per stamp in older mills was at the rate of about fifteen square feet per stamp, for example, it is now, in some cases, in post tube-mill amalgamation schemes, as low as two square feet per stamp unit.



Plate House showing launders from Tube Mills, Brakpan Mines

The result of the introduction of the tube mill has been that the ordinary stamp has been relegated from its all-important position as a crushing machine to a secondary and somewhat indeterminate one as a sort of intermediary between the rock breaker and the tube mill. If the latter machines are made to advance a little more on either side, the raison d'être of the stamp battery may be so much obviated as almost to justify an elimination in favour of machines that are better adapted to the situation. Whether the saving to be gained in the way of capital expenditure, and the consequent interest, is likely to compensate for the advantages of simplicity and reliability which are

possessed by the stamp type of crusher is a matter that is open to a great deal of argument.



Simmer and Jack Arrangement
Three stationary plates in tube mill circuit

Cyaniding.

The ore having been crushed or ground to a sufficient fineness, and having yielded its amalgamable gold to the plates in the tube-mill circuit, flows in a stream as "final pulp" to the cyanide plant. Here the operation of cyaniding is divided into the treatment of sand and that of slime. The treatment of sand, more or less slime free, from the early days when the McArthur-Forrest cyanide process was first introduced, has been a matter of no great difficulty. The treatment of slime, on the other hand, was for a long time a problem which taxed the inventive ability of the most resourceful and experienced metallurgists. Sand could be dealt with by allowing cyanide solution to percolate through the mass until the best economic results were obtained; slime, owing to its practically impenetrable character, was obviously not susceptible to percolation methods, and the only other alternative, that of repeated agitation in cyanide solution, followed in each instance by settlement of the slime and decantation of the gold-bearing solution, was faced by the difficulty that settlement was so tedious and unsatisfactory a process that it quite prohibited treatment schemes in which the time factor was of some importance. The discovery of lime, as a cheap and effective precipitant, removed the chief obstacle to progress in this field, and slime treatment quickly became an integral part of the recovery operations of most Rand mining companies.



Sand Collecting Vats and Slime Treatment Vats, Roodepoort United.

"Slime," says H. A. White, in "A Text Book of Rand Metallurgical Practice," "is the name given to that portion of crushed ore which, owing to its minutely sub-divided condition and the presence of colloidal substances, settles very slowly in water and cannot be leached without extra pressure." "The percentage of slime produced," remarks W. R. Dowling, in the same work, "depends on various conditions, amongst which may be mentioned nature of the ore, amount of rock milled with the ore, the system and efficiency of classification, and the method and degree of fineness of crushing. The product collected in the slime plant represents between twenty-five and fifty-five per cent. of the weight of ore crushed. At the same time, variation in the percentage of slime produced may be due to differences in the ore treated. For example, oxidised ore mined near the surface is liable to yield more slime; and clayey matter in the ore tends to be converted into slime, practically irrespective of the fineness of crushing. From a metallurgical standpoint, however, any portion of the ore, whether pyritic or silicious, which is reduced to a sufficiently fine state of division to pass a two hundred-mesh screen with 0.003 inch aperture, is regarded and treated as slime; hence the finer the crushing the more of this product is naturally obtained."

The presence of slime in sand is an obstacle not only to efficient percolation, but to that aeration of the sand in the vats which is necessary to efficient cyanidation. It involves, also, the retention of an appreciable quantity of valuable gold-bearing solution as combined moisture. The presence of sand in slime is, on the other hand, detrimental to effective slime treatment because the time required for slime treatment is too short to allow of the complete dissolution of the larger and less easily attackable particles of gold which adhere to the sand, and, moreover, the abrasive action of sand in the pumps which are used for transferring slime from one point to another is altogether undesirable. It is of prime importance, therefore, that as complete a separation as possible should be made of these component parts of the final pulp before the operation of cyaniding is commenced. In earlier days a natural separation was obtained by the simple method of allowing the pulp to run into pits, where the heavier sand settled more or less rapidly while the slime was carried further along the stream and deposited itself elsewhere. The unsatisfactory results which followed led to the installation of various hydraulic appliances which were capable of adjustment and yielded a cleaner sand, and these in turn have been succeeded in modern plants by the cone type of classifier to which reference has already been made. The classifier plant is now a most important and carefully thought-out part of the cyaniding scheme, and different arrangements of primary, secondary, and safety cones are adopted, the object of which is to free the sand of every trace of slime and rid the escaping slime of every particle of

sand, the latter portion of the work being the special business of the "safety cone" or "return sand cone" as it is variously called.

The final pulp then, having been elevated by means of bucket-wheels or, as in most recent plants, by centrifugal pumps, of which the Robeson-Davidson type is the most prominent, flows to the classifiers whence the clean sand passes along launders to the sand-collecting vats, while the slime flows to the slime plant.



Conveyor Belts from Collecting Vats to Blaisdell Distributor, Crown Mines.

The large size of the vats used nowadays in the cyaniding process on the Rand is in striking contrast to the modest dimensions observed in older plants. Economy in capital expenditure and convenience in working has led to the adoption of a few large treatment units in place of many smaller ones, and it is not now uncommon to find sand vats with a diameter of fifty feet and a capacity of nearly eight hundred tons. They are usually constructed of mild steel plates riveted together. At the City Deep and Nourse Mines the collecting vats are of reinforced concrete, erected on reinforced concrete columns, but engineers, generally, have preferred the less unusual and simpler methods of construction. In earlier plants the collecting vats were built directly over the treatment vats, into which they discharged directly; latterly, however, the practice has been to erect them upon separate areas and to convey the collected sand to the treatment vats by means of conveyor belts.

The principal features of cyanide vats for sand collecting and treatment purposes are the filter bottom of wooden gratings covered with jute matting overlaid by a mat of cocoanut fibre, and protected by strips of wood known as "shovelling strips," the whole well fitted and caulked where required, and the circular discharge doors of pressed steel, with rubber or other ring packing to prevent leakage.

The sand from the classifiers flows along launders to the centre of the collecting vats, whence it is



Dewatering Cones at Sand Filling Site, Simmer and Jack.

distributed by a series of pipes, of different lengths, arranged radially around a hub, and which, being curved at the ends, are rotated by the impulse of the outflowing streams. The apparatus is known as a "distributor." An alternative method is that of using two or more suitable hoses, but the results are not nearly so satisfactory. The stream of sand is distributed into a vat which has already been filled with water, and in this way an opportunity is afforded of still further eliminating such slime as may have remained with the sand. An annular launder encircles the outside of the vat, and the overflow goes to the slime plant, after having first of all passed over a final series of "safety" cones, which serve to trap escaping sand.

When one collecting vat has been filled, the sand stream is diverted to another collector, and draining is begun from the bottom of the first, assisted, if necessary, by a vacuum pump. Lead acetate is sprinkled upon the charge, before transfer, for the purpose of precipitating the soluble sulphides. Transfer of drained sand is effected, as explained already, either directly into treatment vats below, when the plant is arranged on the double-deck system, or by means of conveyor belts running below the discharge doors when the treatment plant is placed apart. The vats of the latter are similar to those of the collecting system. When filling has been completed, a preliminary alkaline wash, to neutralise free acide and acid salts due to pyrite in the banket, is given, if protective alkali in the form of lime has not already been added to the ore before milling, as is commonly done. A charge of cyanide solution, of a strength of about 0.12 per cent. KCN, is then pumped on to the sand charge, and, after it has been drained off, a second wash of weak solution, of strength 0.02 to 0.03, is given, followed, after draining or "leaching dry," as it is called with a further wash of similar strength until solution to the extent of about one hundred to one hundred and forty per cent. of the weight of the charge has been passed through altogether. Very weak solution, or water, to wash out the previous solution remaining as moisture, is then put through the charge, and final draining takes place, after which the sand is discharged to trucks or conveyor belts by mechanical means or by hand and sent to the "residue" dump. At some of the mines, where "sand-filling" in the abandoned stopes is in vogue, the sand from the vats is shovelled into a launder in which a stream of water flows, and is thus conveyed to a point near the shaft or borehole down which the filling is carried in pipes. The water required to transport the sand from the vats to this point is removed to the degree desired by means of cones similar to those described as constituting the classifier plant.

Some five years ago, during the course of an enquiry as to the possibility of effecting economies in the capital expenditure incurred in the erection of cyanide plants, it appeared to Dr. W. A. Caldecott, the consulting metallurgist of the Consolidated Gold Fields group, that an opportunity was provided in the matter of the costly collecting vats. A series of experiments in sand collecting led to the invention of the sand-filter table and, incidentally, of the diaphragm cone classifier, each of which bears his name and has come largely into use on the Rand. The Caldecott diaphragm cone classifier has been found so admirably adapted to classification and dewatering purposes that it has now become an essential part of nearly every modern installation in which these processes have to be provided for.

The filter table is really a shallow annular launder or trough, of convenient depth, in which a filter cloth is

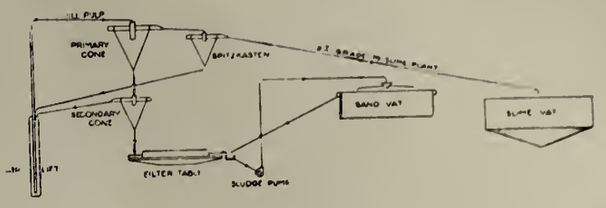


Caldecott Cone Classifiers and Filter Tables, Simmer and Jack.

carefully laid over a wire grating supported upon wood strips. The drainage chamber, below the filter cloth, is connected by pipes to a central column which is, in turn, connected to the receiver of a vacuum pump. The table, up to twenty feet or so in diameter, with a bed two and a half feet wide, is rigidly attached to steel framing, and the whole is supported on rollers and driven by spur gearing at about one-third of a revolution per minute. The sand is delivered on to it from cone classifiers with about thirty per cent. of moisture, and rapidly drains under the action of the more or less steady vacuum which is maintained below the filter. A fixed plough, raised sufficiently to permit of a permanent undisturbed layer of about one and a quarter inches of sand remaining upon the filter, continually diverts the drained sand to a launder as the table revolves. The moisture is reduced to about twelve or fourteen per cent., and the sand is ready for immediate cyanide treatment. The sand may be transferred by conveyor belts to treatment vats to undergo the processes already described, or it may be discharged from the table into a stream of cyanide solution and carried to a centrifugal pump for elevation to the vats. By the latter means cyanidation begins at once and the succeeding washes may be half completed in the same time that it takes to begin it in the ordinary way.

This continuous process has numerous advantages in addition to the obvious saving of time in collecting —the general effect being expressed in a better and more rapid extraction of the gold values.

The following notes with regard to a plant installed at the East Rand Proprietary Mines are given in the "Chemical, Metallurgical, and Mining Society's Transactions": "The combined East Rand plants of four twenty-foot sand-filter tables, each with their complement of four primary cones (nine feet × eight feet) and two washing cones (eight feet × five feet) have for some months been handling the sand from approximately four thousand tons of tailing per day, equivalent to nearly one and a half million tons of ore per annum, and effecting a separation of a little over fifty per cent. of the pulp as a slime containing on the average under two per cent. remaining on a two hundred-mesh screen. The slime content of the sand, determined by elutriation, is under one per cent., giving a product of extreme leachability in the condition in which it is collected. The collection takes place in vats full of solution, and the distribution is by Butters' distributors, the solution overflowing the periphery and returning to the launder carrying the sand from the filter tables." The following diagram shows the system of handling referred to:—



The gold-bearing solutions which drain from the sand-treatment vats gravitate to the extractor boxes, where precipitation of the gold is effected.

The method of handling the separated slime may be concisely described in the following words taken from an article on "Works Practice" in "A Text Book of Rand Metallurgical Practice," by W. R. Dowling: "The treatment of current slime by the decantation method is briefly as follows: The slime pulp flowing from the sand plant is first passed into spitzkasten, or separating, cones to remove any sand that may have escaped collection. The overflow from these return-sand separators is conducted to the centre of one or more vats, where the slime settles to the bottom of the vat and the clear water overflows at the periphery. . . . When sufficient slime for a charge has been collected, the stream is turned into another vat, and the clear, supernatant water in the first vat is drawn off by means of a 'decanter,' which can be lowered down to the level of the settled slime. The slime is then transferred with cyanide solution into another vat in which the slime settles for the first time after coming into contact with cyanide solution. This vat is known as the 'first settlement vat' or 'first wash vat.'

"The gold is dissolved in the course of the transfer with cyanide solution and subsequent circulation of the

RAND MINING IN PICTURE



Battery Floor, Benoni Consolidated

charge of pulp through a pump to keep the whole mass in agitation. The ratio of solution to solid in the first settlement vat is between three and a quarter and four to one. When agitation is stopped, the slime settles, and the comparatively clear gold-bearing solution, termed 'first wash,' is decanted off, clarified further by passing through sand filters or filter presses, and passed through the extractor boxes where the gold is precipitated.

"After the removal of the solution, the settled slime is again transferred, with gold-free solution, to another vat known as the 'second settlement vat,' and is again allowed to settle. The supernatant solution, termed 'second wash,' is drawn off by a decanter, and the slime is discharged with water or precipitated solution to residue dams. The treatment, therefore, consists of agitating the slime with cyanide solution to dissolve the gold, the operations of settlement, dilution, and decantation to remove the dissolved gold being repeated as often as is profitable. With the average low-grade Rand slime two washes only are justified."

A "decanter" consists of a pipe of suitable size with a hinged joint near the bottom of the vat, by means of which the upper end, to which a wire screen is fixed, can be lowered with the level of the solution as the latter is withdrawn through the pipe. The term "current slime," above used, refers to the slime which is separated from the sand of the mill pulp as it comes from the battery. Many gold mining companies have, or have had, large assets in the shape of "accumulated slime," which was deposited as a waste product in the days before slime treatment had reached a practical stage. These terms are commonly found in company reports and in the monthly statistics of the Transvaal Chamber of Mines.

The use of lime, as has already been remarked, is an important factor in the successful treatment of slime, without which it would be impossible to deal with the large quantities usually handled in modern plants. The lime not only neutralises the acidity arising from the oxidation of the pyrite and prevents the formation of acid compounds, all of which are detrimental to efficient cyaniding, but, as a flocculent, it agglomerates the particles and hastens a settlement which might otherwise be indefinitely prolonged.

The transfers and discharges are carried out by means of centrifugal pumps specially constructed for the work, known as "sludge pumps," and the pumping installation is, as can well be understood, an important portion of the slime plant. These and all the other pumps required for the various needs of the cyaniding operations, such as the delivering of solutions and water washes to sand charges, etc., are usually installed in one department, known as the pump house, and the application of electric power to mining and recovery uses has greatly facilitated this arrangement. The gold-bearing solutions, before being allowed to flow to the precipitating boxes, must be clarified, and this is effected in sand-filter vats or, as in more recent plants, in filter presses.

In some instances, as at Brakpan Mines, the agitation and aeration in solution which is performed in the ordinary way by sludge pumps, is carried out in air-lift vats, Brown agitators, or Pachuca tanks, as they are variously called, forty or fifty feet deep and from ten to fifteen feet in diameter. The bottom is conical, and a central pipe, ten to twelve inches in diameter, is carried down to a point near the bottom of the vat. A jet of compressed air is directed up this pipe when the vat has been filled with slime pulp containing the necessary strength of cyanide, and the charge, impelled upwards in this way through the pipe and returning down the outer portions of the vessel, is continually circulated until the gold is considered to have been sufficiently dissolved. The decantation of the solution is effected in the ordinary way in other vats to which the pulp is transferred.



Butters' Vacuum Filter Plant, Brakpan Mines

During the last year or so the Butters' vacuum filter for the treatment of slime has been adopted on the Rand with excellent results. The principal feature of the process employed is the substitution of vacuum filtration and washing of the treated slime pulp for decantation. The nature of the plant and course of operations will be easily understood from the following description of the plant at the Crown Mines. The installation of a three hundred-leaf Butters' vacuum filter slime plant at the Crown Mines is unique not only on account of its being the first vacuum filter plant erected on these fields, but that it should occupy the site of the

first slime plant designed and erected on the Rand by Mr. J. R. Williams in 1894.

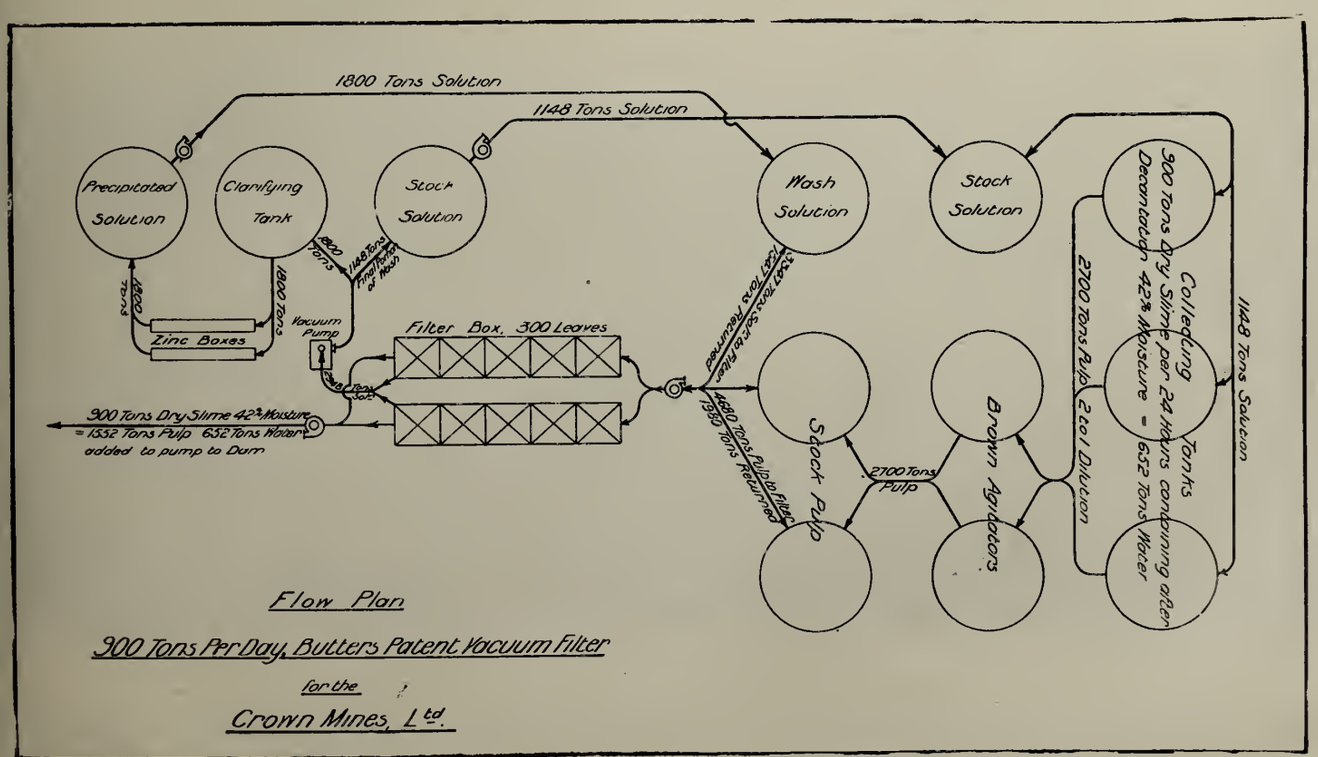
Butters' Vacuum Filter Plant.

The plant consists of two stock vats equipped (temporarily) with air agitation to keep the slime in suspension. After the values have been dissolved in Brown agitators, the pulp at a dilution of two to one is transferred to the stock pulp vats, from where it is fed to the filters as required.

Each filter box is an independent filtering unit. One ten-inch Robeson-Davidson slime pump handles pulp and solution to and from the filter boxes and the stock vats, serving the boxes alternately. The piping is arranged round the pump in a loop, having four valves interposed so as to reverse the direction of flow through the pipes. The pump is set in either the emptying or filling position instantly, by means of one pilot valve introducing hydraulic pressure into the cylinders of the four valves simultaneously. The motor for the ten-inch pump and also valves in the pump systems are operated from the switch board. The style of plant is called the "pumping system," and the process of filtration is performed as follows: The filter box is filled with pulp to a point over the top of the filter leaves, and a valve opened connecting the vacuum pump directly with the filters. Clear cyanide solution is drawn from within the filter leaves and delivered to the clarifying vat for precipitation, the slime remaining as a cake on the outside of the filters. The filters are kept submerged by refilling the box at intervals, and jets of air are introduced at the points of each hopper to keep the slime in suspension. When a cake one inch to one and a half inch thick has been formed, the surplus pulp is pumped back to the stock plup vat, and the box is then filled with solution to wash the cake. During the time of forming and washing the cake, the vacuum is maintained at the highest possible point, but when the cake is exposed to



Extractor Boxes, City Deep



air during the transfer of pulp and wash solution, the vacuum is reduced to five inches to prevent the cake cracking.

The cake being formed by atmospheric pressure, the resistance and permeability is equal over the whole surface of the leaf, thus producing an ideal condition for the recovery of the valuable moisture contained therein, which equals thirty to thirty-five per cent. Sufficient wash solution (about two tons per ton of slime) is drawn through the cake by the vacuum pump to effect a complete displacement of the original moisture. A portion of this solution goes to the clarifying vats for precipitation; the flow is then diverted to a stock vat to be used in making up new charges in the Brown treatment vats. When the wash is complete, the vacuum is disconnected and a reverse flow of solution (by gravity from the vat on the roof) is introduced to the interior of the filters, causing the cakes to drop. The surplus solution is then pumped from the filter box through decanters and returned to the wash solution vat. The mass of thick sludge remaining in the box is diluted with water and agitated with air for a few minutes to make a homogeneous pulp of one to one, which is then pumped to the residue dam by a second, ten-inch R. and D. pump, the delivery pipe of which is fitted with an automatic sampler.

Cycle of Operations :—

Filling box with pulp and forming cake ...	45 minutes.
Transferring and washing	70 ,,
Discharging	20 ,,

Total time of cycle, two hours fifteen minutes.

Tons treated per cycle, one and a quarter inch cake= fifty tons each box.

Five leaves are removed from each filter box every day, thoroughly washed with a spray of water and air, and then immersed in a vat of two per cent. hydrochloric acid solution, for the purpose of dissolving the calcium carbonate and keeping the leaves soft, pliable, and in good working condition. The HCl solution is passed through the leaves in reverse directions alternately by means of an automatic arrangement that requires no power or attention. The leaves are removed from the acid bath after four to six hours' treatment, again washed with the spray, and returned to the filter box.

There is some dissolving of gold, incidentally effected, during the process of filtration; however, the Butters' filter is essentially a slime washing machine, purely mechanical in its functions, and might be termed a process of forced decantation.

Precipitation.

The final operation in the cyanide works is that of precipitating the gold from the solutions, and this is accomplished by passing the latter through long wood or steel boxes, known as "extractor boxes," arranged with compartments in which the stream of clarified gold-bearing solution is made to flow leisurely through closely packed lead-coated zinc shavings or threads. As a result of the chemical reactions which occur, the gold is precipitated and forms, with some of the zinc which is consumed in the process, and various impurities present, a thick sludge at the bottom of the boxes. The periodical "clean up" consists in collecting the precipitated material by washing from the compartments as thoroughly as possible, transferring the sludge or slime to acid treatment vats in which the zinc is dissolved out by means of sulphuric acid or bisulphate of soda, and, finally, washing the insoluble residue, which is filter pressed into cakes and sent to the smelting department.

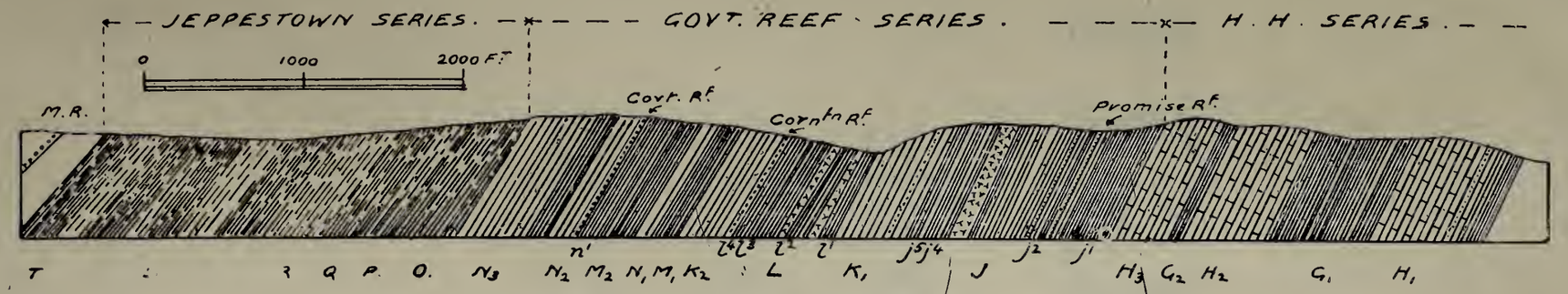
A Model Plant.

The plan and elevation of the reduction works at the Brakpan Mines, which accompany this article, one of the most modern, admirably arranged, and successful recovery plants on the Rand, will serve to illustrate and elucidate the course of the various operations briefly described.

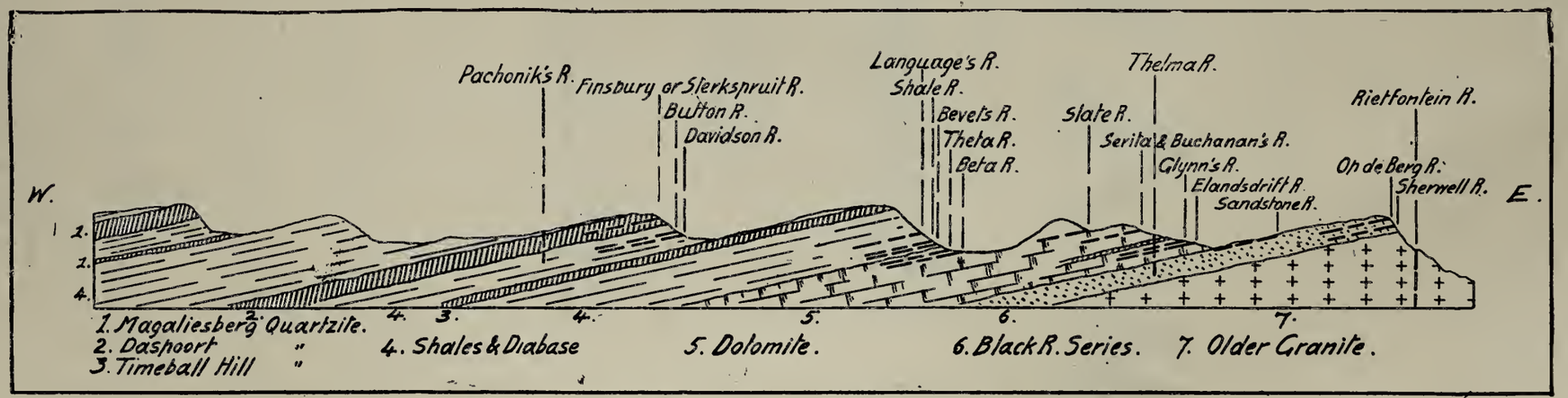


General View, Brakpan Mines.

Geology of the Transvaal



Section of Lower Witwatersrand, Witpoortje



Diagrammatic Section Showing Principal Reef Horizons in the Lydenburg District

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Some Features of Mining in South Africa

Practical Notes on Points of General Importance in the Various Forms of Mining

By J. ALLAN WOODBURN
(Manager, Messina Copper Mines)

IN dealing with mining in South Africa, the Witwatersrand bulks so largely that one is apt to consider the methods adopted there are the only, or at least the best, methods of mining, because they are carried out on such a large scale. There are, however, diamond mining, coal mining, flat-quartz reef mining as at Pilgrims Rest, vertical and highly inclined quartz reef, and pipe and lens mining, as in the East and North Transvaal and in Rhodesia. Each district can learn a great deal from the methods of the other, and much is common to all. Mining may be considered under the following heads: (i.) Shaft sinking, hauling, and pumping; (ii.) development and methods of working; (iii.) tramming, shovelling, and ventilation. Each of these heads must be considered in dealing with any proposed workable area. If the points common to all mining be considered, rather than adopt the idea that diamond mining is quite distinct from gold mining, and gold mining quite distinct from copper or coal mining, then the good points applicable to all would be accepted as sound mining practice, and any modification would be due to the nature and lie of the rock to be mined more than the nature of the mineral it contained. The mineral values may be regular or patchy, may occur in shoots, pipes, or lenses, all of which will decide where the shafts, drives, winzes and stopes will be worked, but the nature of the rock to be taken out and the nature of the walls of the excavation, known as footwall and hanging wall, coupled with the depth from the surface and the thickness of the rock to be taken out, will determine the method to be adopted in mining, and it is the ability to thus determine the best method, and carry it out successfully and economically, which constitutes the skilled miner, as compared with the capable rock drill man who has never done other than rock drill work.

In shaft sinking the question of a vertical or inclined shaft depends on the dip and regularity of the reef, and whether it outcrops near the surface. It should always be borne in mind that a vertical shaft is more efficient than an incline, and should be recommended unless it entails too long crosscuts to the reef, and the compound shaft should only be adopted after very careful consideration. The shape of the shaft, whether rectangular or circular, depends on the nature and depth of the strata to be sunk through, the quantity of water to be met with, and the volume of ventilation to be passed through the shaft. Most of the deep shafts on the Rand have been fortunate in passing through suitable strata for the rectangular shape, but the horse power necessary to pass a large volume of air up a deep rectangular shaft is fully fifty per cent. greater than up a circular shaft of equal area, which is a constant charge throughout the life of the mine. It is interesting to note that an eighteen-foot circular shaft has just been completed 3,700 feet deep at the Champion reef in India, with four winding compartments, two having cages and two skips. The question of ventilation was one which evidently assisted in deciding in favour of the circular form.

Another question which may be considered under the head of shaft sinking is whether the two shafts required by law should be placed close together or about a mile apart, as has been the practice on many large areas. Much can be said in favour of placing the shafts close together, so as to have all the surface plant under the same supervision. Connection can be established as soon as sinking is finished and can be maintained by carrying two inclines close together to the dip, one being a downcast and the other an upcast. In this way fresh air would always be available at every station, and obviate the necessity of relying on compressed air for special chambers, as was suggested by a recent writer. If connection can be made with an adjoining property, then a single shaft on each property will suffice, but the practice of placing two shafts a mile apart cannot be recommended except for the chance of one shaft getting much richer ore than the other in the early stages of development, which knowledge may be of great value to a company. When the shafts are far apart, connection is generally made in the upper levels, and many lower levels may be working, and sometimes stopes may be started before connection is made at that particular level between the shafts, which greatly retards efficient ventilation.

Regarding hauling and pumping, both may be regarded as having points common to all mining, depth and tonnage and quantity of water being the determining factors. As to whether skips or cages be used is decided principally by the shaft being an inclined or a vertical one. Cages have the great advanage in being able to bring loaded trucks from as near the working face as possible right to the surface, and waste rock can be kept separate from the ore. Expensive ore bins at each level are not then necessary, the storage in the mine being obtained from the large number of trucks always in circulation. A larger number of men can be lowered or raised by cages than by skips. Where, however, a large tonnage has to be dealt with from one deep level station, skips are more suitable, as a large storage bin can be made which will serve the life of the mine, but cages should be installed in another compartment of the

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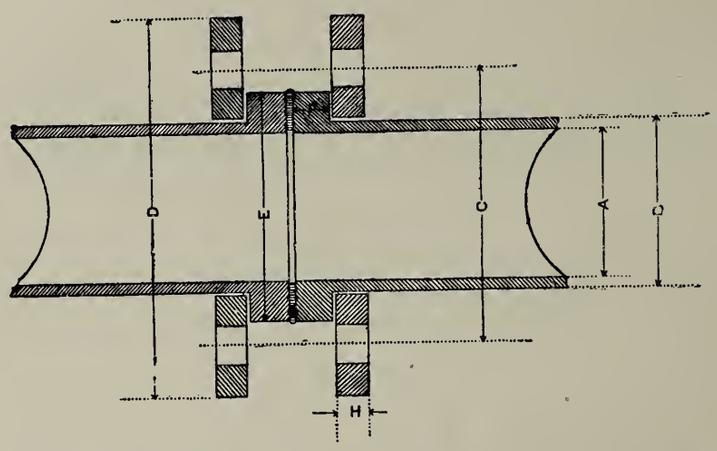
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LARGE STOCKS CARRIED LOCALLY AND AT THE COAST

same shaft or in the adjoining shaft to deal with men and waste rock. Where the reef is flatter than twenty degrees, much might be done with trucks instead of skips in main inclines, these inclines being driven diagonally across the dip, and some system of haulage adopted which would land the ore and waste rock close by the bottom of the two shafts, to be hauled up either. This would do away with expensive crosscuts and ore bins at each loading station.

Development and Methods of Working.

The different methods of working are determined by the thickness of the reef, the depth and hardness of the enclosing country rock, and the dip of the reef, rather than by the mineral to be extracted. In South Africa most coal seams are lying almost horizontal or at a very flat dip, and at no great depth from the surface, so that the methods adopted are all much alike, but in many parts of the world coal seams are worked from twelve inches thick to twelve feet thick, and at all angles or dip from almost vertical to almost horizontal, and at varying depths to between three and four thousand feet. Many modifications of various methods have, therefore, been adopted, all of which are more or less applicable to metal mining. For ventilation purposes the workings are generally laid out in separate panels or districts, so that should a fire take place in one district, it can be walled off or isolated. Double roadways are generally carried along close together so as to get good ventilation close up to the working face.

Rand gold mining has much in common with coal mining, only the rock being mined is much harder. Where large stopes are taken out, pillars are usually left in much too small, and are liable to be a source of danger rather than safety. Where a modified system of longwall is worked, and the worked out stopes backed with waste rock or sand, not only is greater safety secured, but ventilation is much improved by being easier distributed.

Development is generally carried on by long single drives well ahead of the stoping area, and in the deeper mines two to three hundred feet apart, so that connection between these drives is not frequently made, and there is great difficulty in getting fresh air to the working face other than the exhaust from the rock drills. If two drives were carried on close together, one in the reef and the other to the dip or underneath the reef, connection could be frequently made, and good ventilation would be the result. The drive in the reef would be crooked and would give opportunity for sampling, and if the second drive were brought along one hundred to one hundred and fifty feet behind, it could be driven with fewer bends and made more suitable for tramming and haulage, and stoping could be started right away from the upper drive, without the necessity of making boxholes, as the connection regularly made during development would form the boxholes for stoping. These two drives would increase the cost of development, but would not double the cost, as, being close together, the same contractor could have charge of both. Better ventilation would allow of better work being done, and a great saving would be made in stoping, as previously shown. Tramming costs would be reduced, as the main drives would be much straighter and better laid off for this purpose.

In wide vertical or highly inclined lodes, as are being mined in outside districts and in Rhodesia, if only one drive is made along the reef, it is generally crooked and bad for tramming. Either a large pillar has to be left immediately above for protection, which may mean too great a loss of valuable ore, or, if no pillar is left, very heavy timbering must be put in to cover the main roadway, which is expensive, and may require occasional renewals before the tramming is finished on the level. With two roadways, one ahead in the softer lode and the other in the hard country rock, and these connected by crosscuts, much timber is saved, as the stopes can be packed right up from the floor of the drive, and only the crosscuts kept open, and less renewal of timber is necessary. Should a repair be necessary in a main roadway, where the reef is right above and supported by timber, the traffic on the whole level may be stopped during repairs, but when a second level is driven, any repair is confined to its own crosscut. It is also a convenience having the boxholes off the main levels, so that a truck filling at any box does not interfere with the traffic in the main roadway.

Two roadways are not such a necessity where the lode is narrow and the walls are good, if levels are driven not more than one hundred to one hundred and fifty feet apart. Where large areas of mineral have been wholly extracted, various methods of filling have been adopted, from the packing of waste rock got in working, like the longwall method of coal mining, to the filling in of wide vertical reef with waste rock either got in the development at higher levels or sent down from the surface. Whether this is coarse rock, fine sand, or tailings does not alter the principle of packing the area extracted to support the walls and allow of a more gradual coming together of foot and hanging walls. Unless this is done, sooner or later there is serious trouble owing to the caving of the walls and general crush of the whole strata.

Tramming, Shovelling, and Ventilation.

These are affected adversely or otherwise according to the method of working, especially where the reef is flatter than twenty-five degrees. The principal items which affect the distribution of ventilation are the area and shape of the passages and the splitting of the total air current into as many different sections as possible. This can be more easily arranged where double roadways are carried along close to each other, and where the old stopes are filled in so as to prevent what might be called short circuiting. As illustrating the effect of long single airways as compared with splitting into different sections, the following examples may be given: First, two shafts, 30 feet × 6 feet × 3,000 feet deep, with one conecting drive 8 feet × 6 feet; second, two shafts, 30 feet × 6 feet × 3,000 feet deep, with three connecting drives each 8 feet × 6 feet. Assuming it is desired to have 100,000 cubic feet of air in circulation, then in the first case the horse power required would be about 500, and the air would be passing along the connecting drive at about twenty-four miles per hour. In the second case the horse power would be about 100, and the air would be passing along the connecting drives at about eight miles per hour.

These two examples show clearly the advantage of splitting the air into several sections, and this can only be done if the mine is laid off to suit. It is also important, where mechanical ventilation is installed, that the fan be erected so as to assist natural ventilation, otherwise a great deal of power may be wasted if the fan has to act against the natural draught.

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Hints for Hand Stopers in Narrow, Steep Reefs

Prize Mining Paper by JOHN V. MULLER

NOWADAYS, wherever possible, owing to labour shortages and other reasons, hand stoping is gradually giving place to machine stoping; there is, however, one class of reef which it is more practicable to stope by means of hand labour than by machines: I refer to the narrow, steep reefs, such as are found on the Randfontein mines.

Hand stoping is either paid for at a "day's pay" wage or the stopes are given out on contract to the miner. "Day's pay" stoping is gradually dying out, as the miner usually looks upon his work in the light of a "job," and if he is discharged he goes from mine to mine, until he again finds employment. This method of working, then, is unsatisfactory both to the miner and to the management, and the tendency is now, wherever possible, to put the stopes "on contract."

In the latter case, the miner works at a fixed price, which price he agrees to accept and signs a contract accordingly. He now takes more interest in his work, for the more ground he breaks, the bigger his cheque. Nevertheless, a great deal more ground could be broken by the average miner if he would only consider a few simple rules. For instance, perhaps a miner obtains a contract in a stope in which the man before him was of the indifferent type of stoper. When the latter, then, leaves or is "fired," his stope will not be in good shape for advantageously breaking ground. Before his successor, then, can break a fair amount of ground each shift, he has to get the stope into shape. He is, however, afraid of coming out "in debt," and is not prepared to break ground moderately until the stope is in such condition, but simply puts in holes anywhere, and in any fashion, with the result that the stope becomes in a worse state than what he found it in, though he may be a moderately good stoper. In such a case, the correct thing to have done would have been for the mine captain to have paid the new man at a day's pay wage until the stope was in fair order for contracting in. At some mines this is recognised, and the miner allowed so many shifts at day's pay rate to get the stope in shape.

In the case of steeply inclined reefs, the stope should be carried fairly steep throughout, thereby saving lashing; good benches should, wherever possible, be left (in some ground it is impossible to carry small benches), ensuring comfort to the boys in drilling. Here it might be mentioned, is a little thing too often overlooked by the miner. It is generally possible for a "boy" to drill his hole either in a comfortable or an uncomfortable position. By all means give him comfort. The "boy" appreciates this, and will honestly do his best to give his boss a "long hole." If a stope is steep at the top and flat at the bottom, thereby necessitating a lot of lashing, the only course left open for the miner is to "beat back" the bottom, leaving the top portion alone as much as possible until the whole stope is of a uniform steepness.

In planning holes for the boys to drill, the stoper too often neglects to consider at what place his hole will end. This is a fatal error, for a hole might have a good position in a bench, but, owing to the direction it is drilled in, might end up in the hanging or in the footwall, and, on being blasted, tends to weaken the same; besides, good benches can only be left by imagining the position of the hole as it would appear when drilled and what the result will be when the hole is blasted; for a great thing to remember is, that if a good bench is left to-day, another will be required to-morrow. Another small thing, too, so much neglected, is the fact that if a boy drills in one bench to-day, he should be given a hole in the bench which is left the next day. Boys do not like being moved to different places in the stope every day.

Occasionally it happens that a portion of the reef is left on the hanging wall. Unless absolutely necessary —and it should very seldom be so—a hole must not be drilled in this to fetch it down. If the reef is at all narrow, the hole will be sure to pierce the hanging, and on being blasted will weaken the same. The portion of reef so left on the hanging is, of course, connected to the reef in the stope, and if the hole in the bench nearest it be drilled either in the reef or given direction so that it will end in the reef, when the hole is blasted the force of the explosion will be sure to bring that portion left on the hanging down, unless, as sometimes occurs, it is what is generally known as "frozen" on to the hanging.

Another mistake is to allow one hole to depend on another in a "hammer" stope. This should never be done. Let a boy drill two consecutive shifts in a large

RAND MINING IN PICTURE

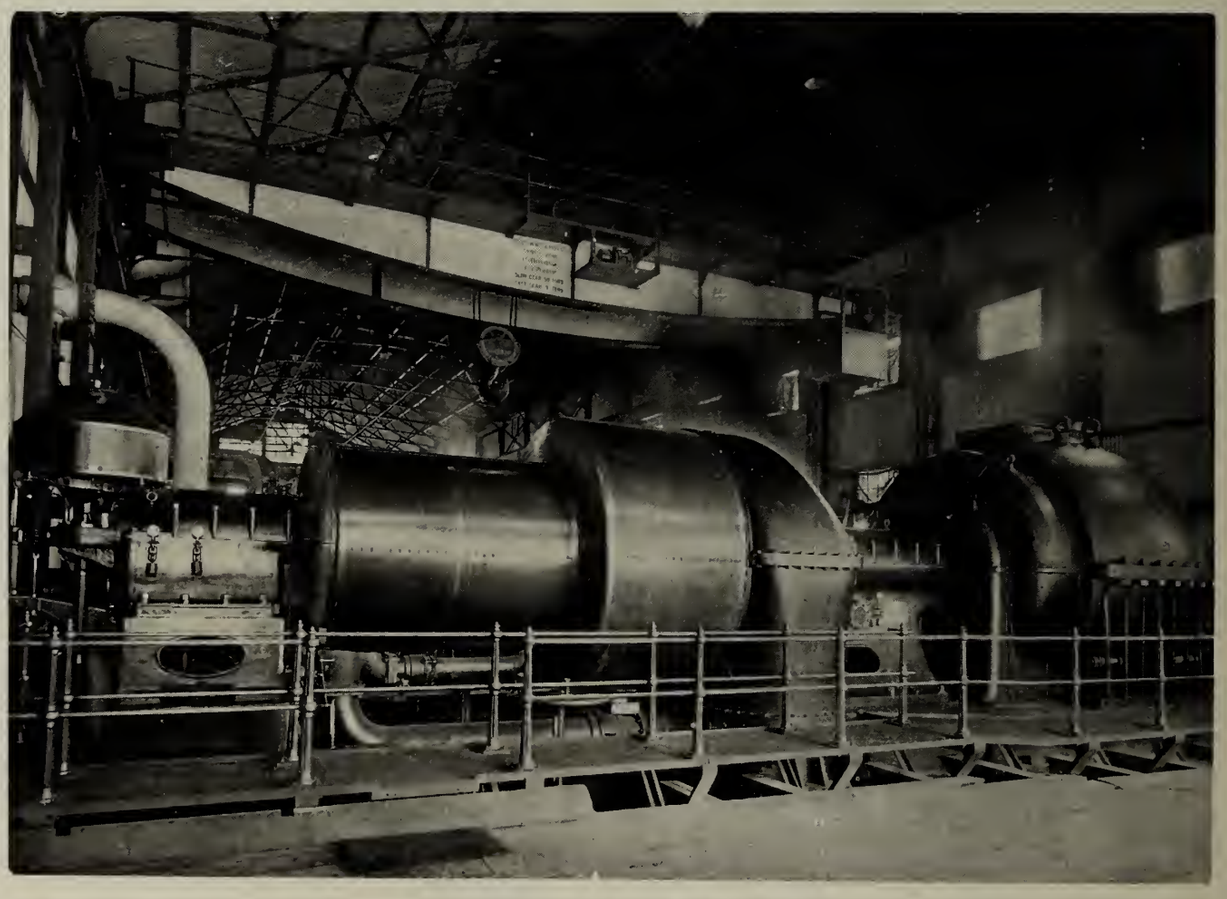


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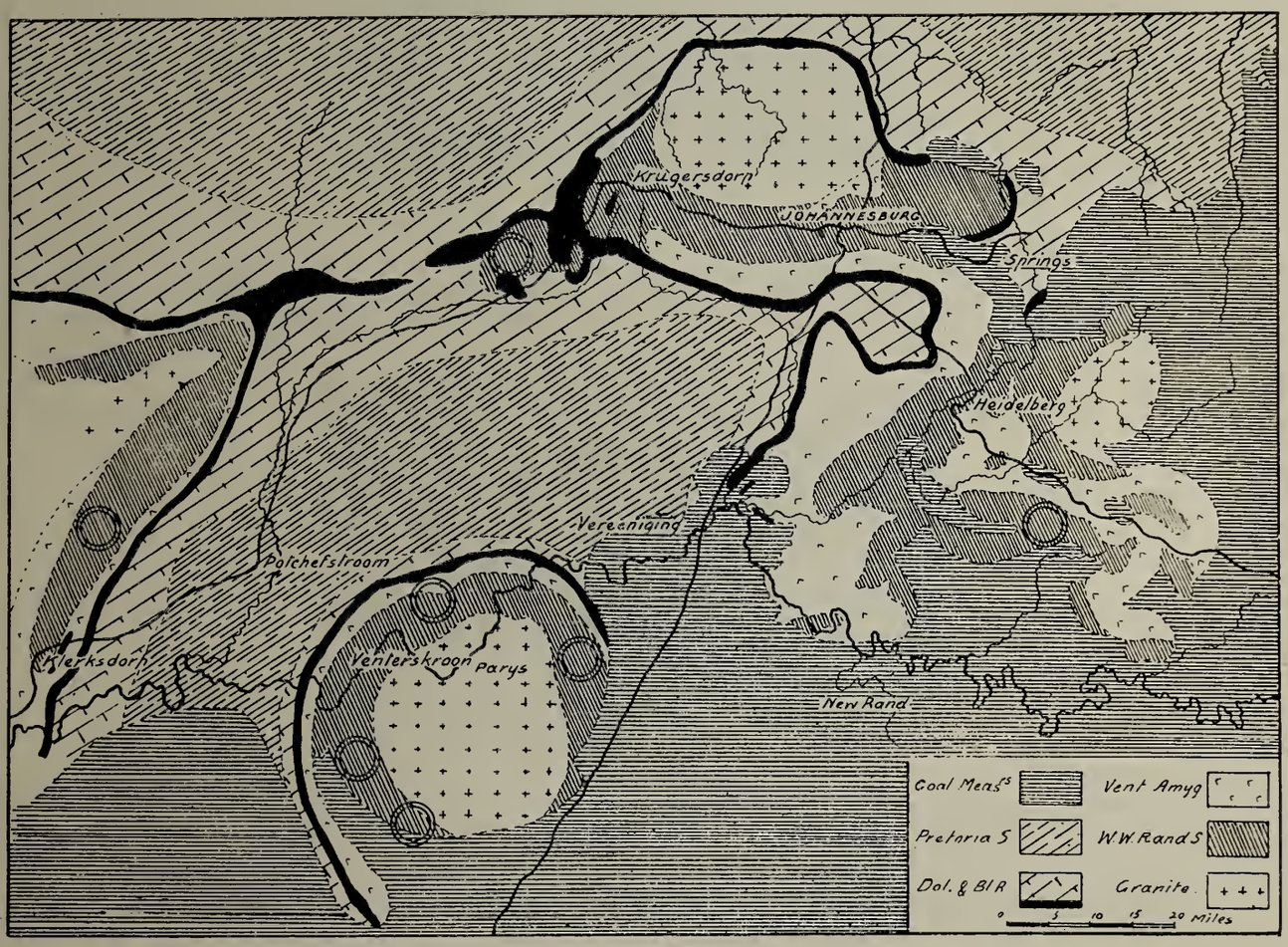
bench rather than have two holes drilled, the one depending on the other.

In charging up, many little things are so often neglected or forgotten. A hole should never be charged unless, whenever possible, all the water and mud therein has been withdrawn by means of the charging or swab stick. All boys use water in drilling their holes. Many neglect to clean out the mud and water left at the bottom of the hole when finished, and the miner, when charging up, often has no time to do so, but leaves it there, and puts the gelatine in. The latter becomes wet, and on explosion the gases generated are slightly cooled through contact with the water, thereby lessening the force of the explosion. Boss boys should always examine each hole, and no drilling boy should be given a ticket unless his hole be clean.

Then, too, the paper "tamps" used are often of a very small size. The diameter of the tamp should be slightly less than that of the bore of the hole. A very slight pressure of the charging stick, then, is sufficient to expand the tamp so as to exclude all the air, whereas if a small tamp be used, it must be pressed home fairly hard, and probably a second one put in, to enable it to break and spread and exclude the air from the charge.

In conclusion, I might state that these remarks are based on actual experience in narrow, steep stopes, and are given in the hope that any hand stoper reading them will find them of value in practice.

GEOLOGY OF THE RAND



Geological Map of the Southern Transvaal, showing Outside Centres of Prospecting Activity

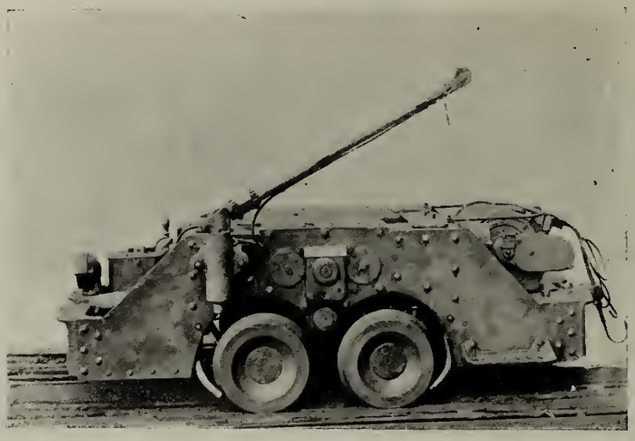
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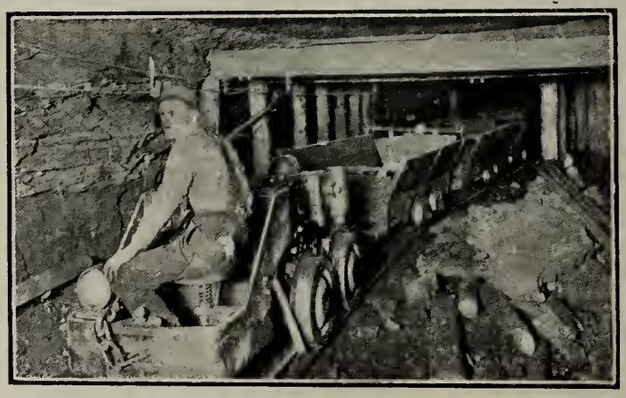
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The Future of the Rand

Coming Greatness of the Industry :: The Relations between the Government, the Country and the Mines

By GUSTAVE IMROTH
(Managing Director, Johannesburg Consolidated Investment Company, Limited)

I HAVE been a good deal impressed by the disposition which I find is fairly general in Europe and here to take a gloomy view of the future of the Rand. The causes of this pessimism have naturally had our attention, and I am inclined to conclude that too much has been made of the adverse factors which have come into evidence. Labour difficulties have no doubt been a drawback to the most economical working conditions, but if one considers for a moment the figures of the gold output for the year, it will be agreed, I think, that the mines are making good progress. There has been a steady increase in the gold output practically every month, and, though labour is scarce, it is impossible to assert that the scarcity has so far affected the progress of the industry regarded as a whole; otherwise the output would have fallen. Just at this time of the year labour is always scarce, but later in the year it will improve again. What are the other adverse factors to which I have referred? I know of none. With the increase of experience and the improvement in machinery, both above and below ground, we are holding our own very well against the factor of labour scarcity. The chairman of the Johannesburg Consolidated Investment Company pointed out last year that that company and the firm of Barnato Brothers put down a sum of one million pounds for the further development of the Van Ryn Deep and the Consolidated Langlaagte mines. At both these points—far removed from each other—the mining developments are favourable and there is no evidence that these properties are less valuable than their outcrop neighbours. Putting up large sums for working capital means that we are confident that the future will at least maintain, if it does not improve on, the record of the past.

Highest Level of Production.

The Rand mining industry has a future before it greater than its past. The output to-day is thirty-six millions per annum, and technical experts tell us that this figure does not represent the highest level of the Rand production. Difficulties and fluctuations there will, of course, always be in mining, but none, I venture to think, that will not in time be overcome. We have had our disappointments and they have taught us lessons. We shall strive to benefit by them. The stability of the Rand has never been greater than it is to-day, and it is a great mistake to magnify the meaning and importance of developments which may here and there affect individual mines but cannot injure the industry as a whole. There is another subject on which I want to say a word or two. The Johannesburg Consolidated Investment Company is very largely interested in the fortunes of this community, and, naturally, while we desire to see staple conditions in the mines, we also wish to see evidences of a general prosperity and progress in all other industries of the Union. It is a mistake to suppose that if we take care of the Rand, everything else can be neglected. This is a big country, and its problems are, or should be, economic. How to develop the country's assets seems to me the main problem for politicians, and I am glad to say that, as far as I can hear, the Government is doing its best to straighten out such economic difficulties as attend in all new countries—such matters as railway administration, industrial development, and, last but not least, land settlement. The country is moving, and such discussions as that on dry farming indicate that other industries than mining are also progressing, and I am glad to see it. Time is needed for these things, and let me recall that the Rand itself is only twenty-five years old, but the work of the country generally will be much facilitated and advanced if we give our sympathy and such assistance as we can to further the progress of our fellow countrymen who are at work in other directions than mining.

Government and the Mines.

In spite of a good deal of talk, there is no evidence that the Government is opposed to the interests of this mining centre, and I am sure, from what I have been able to ascertain, that the mines may be satisfied that nothing will be done to damage their position, nor is it likely that other industries will be artificially assisted at the expense of the Rand. The Government recognises that the industry is bearing the full share of its responsibilities. I do not think that such a matter as increased taxation for the mines is contemplated. I was glad to see and meet a number of members of the Union Parliament who were last year among us on the invitation of the Mayors of Pretoria, Potchefstroom, and Johannesburg. I congratulate the Mayors on their public spirit, and I hope that our visitors gained some first-hand information of our circumstances and our harmlessness. There is no reason why we should take up a hostile attitude to the authorities—or why such a feeling should exist at all—but I say there is every reason why we should, on the contrary, sympathise and encourage attempts now being made to promote the general progress of South Africa.

Reminiscences of the Rand in the 'Nineties

Some Incidents and Contrasts Recalled

By R. G. FRICKER

I ACCEDE gladly to the editor's request to write a few lines for the majority number of the "South African Mining Journal."

First, let me offer you the usual birthday greetings, and may your journal long survive and prosper. It has grown with the Rand; and, like the Rand, from small beginnings, by dint of energy and hard work; and I congratulate you on having developed a mining journal second to none. I can hardly realise that it is twenty-one years since your paper was started and that only twenty-six years ago there was hardly any Rand to speak of. What a contrast between then and now! Between Ferreira's Camp and the few buildings round Market Square when I arrived in '87 and the great city extending over miles of what was then bare veld; between the light five-stamp batteries of those days and the huge reduction works of to-day; between the primitive mining work and metallurgical appliances then in vogue and the scientific practice and plant of 1912.

It is the fashion to abuse the capitalist of to-day—especially if he comes from South Africa—but the Rand owes a great deal to the capitalists of its early days, who showed infinite faith in the place and backed it with their money—and it was not all plain sailing either.

When I first arrived on the Rand the Wemmer, Jubilee, and perhaps one or two other companies had started crushing with five-stamp batteries, soon to be followed by the Crown Reef, Ferreira, and other companies. The Ferreira, following the custom that then existed of placing the battery by the water, had erected theirs at Sans Souci and carried the ore from the mine in Scotch carts through what is now the town of Johannesburg.

Then William Knight erected a hundred-stamp mill, which was fed with ore from open cuttings, but I don't remember how many of the hundred stamps were dropped—not many, I think. When the Nabob battery was started on the spruit where the Consolidated Main Reef dam now is (the starting of a battery was an event to be celebrated by champagne, etc., in those days), the chairman congratulated the shareholders on its being situated on the spruit because the water would carry away the tailings and avoid accumulation. I sold the remainder of those tailings a few years later to Edward Lippert, who was interested in a sands plant erected by Charlie Butters near the old Main Reef office, and I think we agreed the value at five or six pennyweights.

In '88 Sir Donald Currie visited the Rand, and at a public luncheon given him said he believed the time would come when the Rand would turn out a million ounces a year.

In '89, with the drought, came a famine. Forage went to £12 or £13 per hundred bundles (Fillis had his circus in Johannesburg at the time), paraffin to £5 per case, with other commodities in proportion. Flour might have gone to anything had not the President stepped in and told the merchants that if there were any games of that sort he would commandeer the lot. At the instigation of the Chamber of Mines, which had been started the same year in succession to the Diggers' Committee, the Government advertised that they would give £5,000 in bonuses of £20 to each of the first two hundred and fifty wagons that arrived in camp with foodstuffs.

The year 1890 was marked by an event of the greatest importance to the future prosperity of the Rand. The first cyanide plant was erected on the Salisbury mine. In 1891 the output was 729,238 ounces. To this no less than eighty-three companies actually contributed, though I expect such names as the "Citizen," "Evelyn," and "Cornucopia" would convey little to the present generation, and they would search in vain for "Nicholsons" (afterwards the "Wolsingham"), "Howick and Rockley," "Ormerod," which produced gold from '87 onwards, and I wonder how many people could now locate the "Percy," "Cliffendale," and "Northey" properties, which at one time were regular producers.

In June, 1892, the "Doctor" proudly hung out a banner from the balcony of the Corner House with "100,000 ozs." blazoned on it to commemorate the first output of six figures in any one month—though it must be remembered that the output was then declared in retorted gold valued at seventy shillings per ounce, and it was not until after the war that all outputs were returned in fine gold. But I am trespassing too long on valuable space, and will conclude by expressing the hope that the "Journal" may continue the good work it is doing and increase in utility and circulation year by year.

Early Days on the Diamond Fields

A Hitherto Unpublished Document

By THEODORE REUNERT
(Author of "Diamonds and Gold in South Africa")

THE story of the discovery of the Diamond Fields has been told so often that it does not need to be repeated for South African readers. It was in March, 1867, that the first diamond was found in the Hopetown district of the Cape Colony, south of the Orange River, but that district was so remote and inaccessible in those days that more than two years went by before clear proof was afforded of the undoubted existence of payable diamond deposits in South Africa, and it was only in the year 1869 that the first mining camps were formed on the banks of the Vaal River, where, indeed, they continue to exist to the present day. Many and varied are the picturesque accounts that have been written of that golden age of South African exploration, when men lived together like brothers, sharing their good and evil fortune, buoyed up by the sense that there was enough to go round, and that each man's share of luck would come in time. But it is more than forty years ago, and we cannot hope for many more personal reminiscences from the "Sixty-niners." We are, therefore, fortunate in being able to publish (we believe for the first time) an authentic document which has recently come into our hands, and which tells its own story so clearly that it needs no further words of preface.

"To His Excellency Sir Henry Barkly, K.C.B., Governor and Commander-in-Chief of Her Majesty's Colony of the Cape of Good Hope, and Her Majesty's High Commissioner, etc., etc., etc.

The Memorial of the undersigned sheweth as hereinafter set forth:

1. That through a long period, and from a variety of concomitant circumstances, the attention of your Memorialist has been directed with peculiar interest to the subject of geological discoveries, particularly in the branches of mineralogy and metalliferous formations.

2. That holding the commission of Major in the 2nd Battalion of Her Majesty's 20th Regiment, your Memorialist was stationed with his Regiment, in the beginning of the year 1869, at Pietermaritzburg, in Natal; and becoming strongly interested, scientifically, in the earliest rumour of a discovery of diamonds in the neighbourhood of the Vaal and Orange Rivers, and possessing a practical knowledge of the mode of procedure peculiar to mining for precious stones, your Memorialist soon came to the determination of fitting



Kimberley Mine, 1872.

out an exploring party, who received detailed instructions from him to proceed to the locality where surface diamonds were said to have been found, examine the geological formation there, and, if certain proper indications were discovered, proceed to the operation of mining and sifting, adopting, as closely as possible, the method at present in use at the diamond mines of the Brazils.

3. That your Memorialist thus lays claim not only to having been the first person who began the scientific search for diamonds in South Africa, but, as far as he is aware, to being the first person who even suggested such a step. Indeed, so chimerical was the scheme



Kimberley Camp, 1872.

considered, that when your Memorialist wrote to certain well-known mining agents in England, in the month of March, 1869, proposing that they should undertake some small operations, endeavouring, at the same time, to obtain the necessary pecuniary assistance of one or two local firms, the whole affair was regarded as far too visionary to be seriously entertained for a moment; and no wonder, perhaps, when it is considered how wild were some of the theories first set afloat, in circles which should have been better informed, to account for the occasional presence of diamonds on the surface at the Vaal and Orange Rivers. Just one, out of several such theories, may be mentioned as a specimen, and



Sorting Gravel at Waldek's Plant, Vaal River.

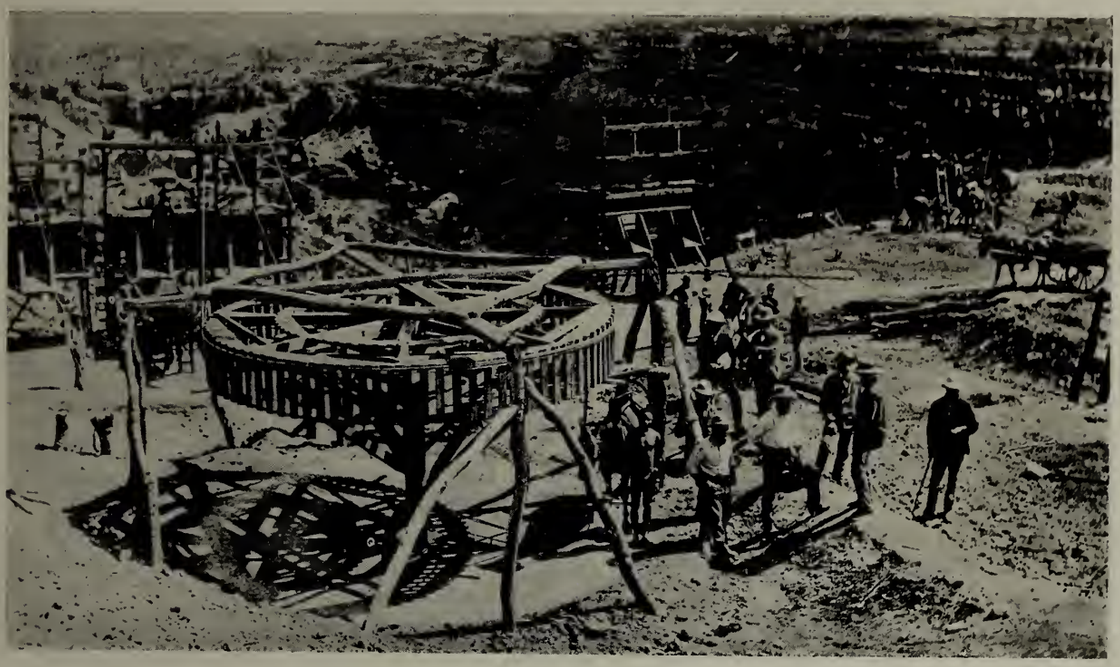
your Excellency will scarcely believe that in some quarters it was gravely asserted that the few diamonds which up to that time had been picked up here and there must have been brought from Central Africa, carried down from the far interior in the gizzards of ostriches.

4. Hence it may readily be comprehended how it came to pass that your Memorialist was left to undertake the first regular search for diamonds (no inconsiderable risk at that time) entirely on his own unaided resources. About this period it was that he fortunately fell in with a few intelligent miners who had come to Africa from Australia on the news of supposed gold discoveries at the Tati, and who had acquired a large experience in different parts of the world, though even then there were none of them practically acquainted with the special branch of diamond mining; and until your Memorialist was happily enabled to secure the services of a Monsieur Gline (a Frenchman) none of the party had ever seen a diamond in the rough state. After much trouble and expense in preparation, your Memorialist, at last, to the no small surprise of the majority of the people about him, succeeded in starting a party for the interior, fully equipped in every way for the arduous duties assigned them.

5. This party, on their departure from Natal, received instructions in detail from your Memorialist to proceed to a particular spot which he had even then already selected, on scientific grounds, as the one which would in all probability turn out to be eventually the most successful, namely, the point where the Harts River joins the Vaal. And, indeed, so sagacious were these early calculations as to the best spot for mining operations, that your Memorialist trusts he may be excused for mentioning that more than two years ago he definitely marked down (on a map still in his possession) the exact place where the Klip Drift Diggings now stand, having been led to this conclusion chiefly by geological considerations from a general description given him at that time of this part of the country, and by the examination of a quantity of stones, pebbles, and gravel, brought down from that neighbourhood by casual visitors.

6. On reaching Wynburg, in the Free State, your Memorialist's party heard that precious stones had been found on one or two of the farms situated on the Vet River, and it was here that (departing from the strict tenor of the instructions which had been given them), they first began to dig—but without favourable results.

The next rumour that they heard was that some few valuable stones had been found near Bloemhof in the Transvaal. Actuated by this report, and moving up there in consequence of it, a month was spent in digging and sifting in that part of the country, but without any diamonds being found. Meantime your Memorialist had constantly kept up a correspondence with his party, strenuously reiterating his first instructions, and advising that no time should be lost in desultory efforts (of the kind they had hitherto been making), but that they should at once proceed to the destination originally agreed upon, the junction of the Harts and Vaal Rivers, and begin operations there. As



First Whim, Kimberley Mine, 1874.

the result of these communications, regular mining was first commenced in the month of December, 1869, just opposite Hebron, and a shaft of thirty feet was sunk with much rapidity. In the first working the colour of gold was found strongly marked, but no other results obtained, so it was decided to cross over to the other side of the river and try there. At last, on the second day of this new working, that is, on the 4th of January, 1870, a diamond of two carats was washed out on the very spot (then almost unheard of) which has since become so celebrated under the name of the "Hebron Diggings." Still, however, in pursuing further operations at this place, your Memorialist's party met with but little additional success; so they soon after moved to what are now known as the "Klip Drift Diggings," where, to their no small gratification—nearly a full year since your Memorialist had first contemplated this enterprise—some fifty valuable stones were washed out in the course of only one week's labours.

7. Such success attending upon a regular system of mining operations, where shaft-sinking was largely resorted to, could not long continue unnoticed; and so it happened that other parties who were now on the Vaal River, but who had hitherto sought for diamonds only on the surface, determined upon following the example of your Memorialist's party, and soon adopted their practical system of mining, with very varying but not, on the whole, discouraging results. From these small beginnings have sprung what are now known far and wide as the extensive and prosperous Diamond Mines of South Africa—destined ere long to revolutionise the whole aspect of affairs in this Colony, and to render that terra incognita, "the Cape of Good Hope," one of the wealthiest appanages of the British Crown.

8. In order to have a clear perception of the beneficial change which has been wrought for this country by the development of the diamond mines on the Vaal, it is almost indispensable that the observer should have been resident in South Africa for at least a few years prior to the discovery. Before that time, for some years back, mercantile transactions of almost every description had received such severe checks that they had well-nigh dwindled down into a listless state of complete stagnation. It was almost impossible to see any feasible way of removing the heavy incubus which brooded increasingly over the depressed state of public affairs. Disappointment and failure had so constantly attended every effort, that the spirit of enterprise, public and private, seemed for the time perfectly paralysed. Indeed, your Memorialist actually heard of a merchant in Port Elizabeth saying that if the people at that place were to find surface indications of gold in their gardens, they would not venture a penny on the risk of mining for it, so unfortunate had every kind of speculation proved of late years. And yet now, so much had the aspect of matters changed, that this very town—Port Elizabeth—is vigorously extending itself in every way to secure, if possible, the monopoly of the inland trade which has lately arisen between the frontier towns and the Vaal.

9. But if this and similar results have been effected in reviving the activity of an old and long-established settlement like Port Elizabeth, what far more surprising benefits must have accrued to the favoured precincts of the Vaal and Orange Rivers—spots which until lately could only be characterised as howling wildernesses;



Barkly West River Diggings, Vaal River.

where land was of such little value that people did not even take the trouble to claim it, and where you might have ridden at any time fifty miles without seeing or even tracing the vestiges of a single human being. And

yet now this desert had become one of the busiest haunts of men—the centre of an immense and ever-increasing population—the emporium of incalculable wealth.

10. Under these altered conditions, territorial claimants, though late in the day, will not have been wanting to spring up on every hand and contest the title to this new Golconda. Into such claims as these, your Excellency, during his recent visit to the Diamond Fields, will have had an opportunity of enquiring. But, after what has been described in the foregoing clauses of this document, your Memorialist sincerely trusts that he will not be considered presumptuous in deeming his claim to be superior to that of any one for a recognition by the Government of his right to be awarded a portion of land in the diamondiferous region—a region which he was the first to explore by organised labour and scientific mining, and in which his own prospecting party, fitted out entirely at his own expense, were the earliest pioneers of the only serviceable method of diamond mining, and were the first who on South African soil obtained precious stones many feet below the surface, contained, he collected a number of precious stones as specimens, took them to His Excellency Mr. Keate, the Governor of Natal, placed the whole of his then information at Mr. Keate's disposal, and offered his services (free of all charge to the Government) to proceed to the spot and so direct the current of events that Her Majesty's subjects in South Africa might reap substantial benefits. Mr. Keate was pleased to accept the offer, but an unlooked-for obstacle arose. Colonel Browne, commanding your Memorialist's regiment and the troops in Natal, was unwilling that your Memorialist should be thus employed without first placing his commission in the hands of his colonel—stating as a reason, that the regiment was under orders for the Mauritius, and that your Memorialist ought to accompany it. Mr. Keate hereupon advised your Memorialist not to incur such a certain loss for so great a contingency. And in pursuance of this advice, when, soon after, the 20th Regiment was ordered to the Mauritius, your Memorialist was obliged to accompany it to that island, leaving, however, Mr. Becher—who had sold out of the regiment for that purpose—and some twenty-five



Dutoitspan Mine, 1874.

thus resolving all doubts as to the existence of diamond *mines*, and dispelling at once and for ever all the vain theories on the subject which have been before alluded to.

11. Should Her Majesty's Government not see fit, however, to take over the full sovereignty and possession of these lands, your Memorialist, in urging his claim to a portion of them, feels satisfied that your Excellency will see the justice of prevailing on those native chiefs, or other territorial claimants whose title may hereafter be recognised by the British Government, to alienate by a grant in his favour a portion of that country which without his efforts might forever have remained the valueless possession it recently was, before the discoveries above described, and of which your Memorialist so strangely, yet so prominently, has been made the means.

12. In preferring this request, your Memorialist is happy to be able to state that he does so not without good claims to the consideration and attention of the Colonial Government; for after he had, in February, 1870, personally visited the scene of operations, and satisfied himself of the enormous wealth the country experienced miners to represent him at the "Fields."

13. The expenses of keeping up such a party have been extremely heavy, and that it is with no small difficulty that your Memorialist has provided the necessary funds, and up to the present time he has scarcely recovered the costs of so laborious and remote an enterprise.

14. Your Memorialist believes it to be customary in Australia, California, and, indeed, most countries, to make grants of land to discoverers and those who open up the mining industries of any important mineral section of the country. Indeed, while your Memorialist was still in Natal, a Bill passed the Legislature promising a large grant of money to any person who should make a *bonâ fide* discovery of gold in that Colony.

15. It is true that the site of the Vaal River Diamond Fields lies without the limits at present assigned to Her Majesty's Colonies in South Africa; nevertheless, your Memorialist thinks it probably that your Excellency will for the future exercise a discretionary control over these new mining districts. Your Memorialist asks but little. He asks only for a few thousand acres of that land which eighteen months ago was as utterly valueless

as so many acres of the Indian Ocean. And it is not self-interest alone that prompts him to prefer this request; other persons are under his protection; the poor and adventurous miners who have already been described as forming his earliest working party are equally interested and await with no small anxiety the time when, by the graceful act of your Excellency, your Memorialist may be enabled to reward practical services which, through so many disappointments, and through such formidable obstacles, have at length, by simple perseverance, brought matters to a successful issue.

16. Finally, your Memorialist would acquaint your Excellency that, if further information be desired as to the date of his suggesting the earliest operations above described to persons in England, he would wish reference to be made to the Honourable H. Coke, 12, Warwick Square, London; also to His Excellency Mr. Keate, Governor of Natal; and the Honourable Major Erskine, Colonial Secretary. Your Memorialist also appends the names of his working party, the first miners who ever obtained diamonds, by operations of that character, in Africa:

Mr. W. C. King.
,, T. T. Gline.
,, W. Boyse.
,, W. Valentine.
H. Becher, Esq. } Superintending, and obtaining
T. Rolleston, Esq. } Stores, etc.

And trusting that this Memorial will meet with the favourable consideration and approval of your Excellency,

Your Memorialist,
As in duty bound,
Will ever pray,
etc., etc., etc."

What happened to the "trusting Memorialist" history does not relate. The way of the pioneer is hard! He "only asked for a few thousand acres of" Griqualand West, and it is much to be feared that he asked in vain.



Difficulties of transport in the early days. Ox wagons crossing a river en route for Barberton.



Pont on the Vaal River



Pont at Windsorton, Vaal River

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The Rand's Ore Reserves

Over One Hundred Million Tons of Profitable Ore Developed :: Figures for Groups and Individual Mines :: Reserves Three Years Ahead of the Mills
£140,000,000 in Gold Awaiting Removal

HEREUNDER is presented a table of Rand ore reserves which has been made as complete as reports and technical statements will allow. The majority of the tonnages and values given below are those developed and valued as at December 31st last. Where such figures are not available, the statistics are culled from the last annual reports published. We have often remarked on the lack of uniformity exhibited in official declarations as to the ore in reserve. No one can realise to a proper degree how great this dissimilarity between the returns of different companies is until an attempt has been made to prepare such a schedule as is given hereunder. Some companies declare their developed ore in terms of mining tons, others in terms of milling tons; that is to say, mining tons subject to deductions on account of sorting. In some instances one comes across references to suspense accounts in ore reserve statements. Certain companies state the amount of ore recoverable in shaft and stope pillars, etc.; other companies do not enlighten one in this respect. These are but a few of the differentiations to be observed. There are, too, naturally many variables resulting from different thicknesses of reef, and therefore different stoping widths, etc., in different mines. Furthermore, as working costs vary materially as between one mine and another, the pay limits vary largely. These latter inconstant factors are, of course, decreed by the conditions peculiar to each mine, and are thus inevitable; but we certainly think it would be to the great advantage of shareholders were the methods of declaring reserves, as between different groups and different mines, brought more closely into line.

Ore Reserves of the Groups.

The tables given herewith classify the ore reserves of the mines according to the various controlling houses or groups, and deal with only "payable," fully exposed, and fully valued tonnages, except in one or two special instances. The group aggregates are as under:—

	Tons.
Central Mining and Investment Corporation	36,999,442
Affiliated companies with head offices in Natal	1,358,800
Consolidated Gold Fields of South Africa...	9,199,000
East Rand Proprietary	6,716,605
Anglo-French Group	1,753,370
General Mining and Finance Corporation ...	5,842,556
S. Neumann and Co.	4,183,962
Johannesburg Consolidated Investment Co.	5,814,231
Randfontein-Langlaagte Group	6,940,166
A. Goerz and Co.	1,949,207
Consolidated Mines Selection	1,925,346
Total	82,682,685

If to this total be added ore partially developed or partially valued, the great bulk of which may be assumed to be "payable," and there be also added the tonnages of pay rock awaiting mining in a few comparatively unimportant mines not included in the above, a grand total of slightly over one hundred million tons is arrived at, a figure approximating fairly closely to that advanced in the "South African Mining Journal" in regard to ore developed at the end of 1910.

Features of the Year's Work.

A small increase is to be observed in the aggregate tonnage blocked out, but nothing very significant or important. Neither is any appreciable difference to be observed in the assay value. During the past twelve months the mines have been engaged in bettering underground working conditions and meeting the continued shortage of native labour by strenuous endeavours to substitute mechanical appliances wherever possible, rather than in advancing development to any remarkable degree. The existing legislation does not encourage companies to advance development very much ahead of the mill. It may also be remarked that the majority of Witwatersrand mines are now in a strong position with regard to ore reserves, and, taking the aggregate reserve for the whole Rand at one hundred million tons on mixed milling and mining bases of estimation, and the annual rate of crushing at twenty-five million tons, the ore blocked out is three years or more ahead of the combined batteries. During the past year some companies largely increased their tonnages in reserve—the Crown Mines, for instance, added close on four million tons to its reserves. On the other hand, some companies, through encountering poor zones, show a decline. The influence of working costs must here have to be taken into account—the raising of the pay limit consequent on higher working expenditure meaning a decrease in reserve, and vice versâ a lowering in that factor (as a result of decreased costs) an increase in the total.

A Vast Hoard of Gold.

We do not propose to hazard any hard-and-fast figures as to what this vast tonnage of ore—this enormous stock-in-trade of the industry—may mean to shareholders in dividends, or to the country in working costs. Obviously the accumulation of such a colossal tonnage of profitable ore ready for stoping makes for industrial stability. Even so, the Rand is still largely at the mercy of legislation, labour difficulties, and a thousand and one other factors. It is, in fact, at the caprice of the Government and the "coloured gentleman" to a degree which deters us from venturing predictions as to the ultimate dividend value of the one hundred odd million tons above arrived at. We may, however, with some degree of confidence, in the approximate accuracy of our calculations, advance the estimate that this tonnage contains gold of a total recoverable value amounting to about £140,000,000.

In the above calculations no account has been taken of the many millions of tons of low-grade ore—the accumulations of years of exploitation—which are standing developed in the mines. Much of this low-grade ore is verging on the profit line. It needs but a happy swing of the pendulum of the industrial clock to transfer several millions of tons from the unprofitable to the profitable side of the Rand's ledger.

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Central Mining and Investment Corporation—

	Tons.	Dwts. per ton.
Bantjes Consolidated ...	896,087	7.3
City Deep	2,078,805	8.1
Crown Mines	10,124,072	7.25
Durban Roodepoort Deep ...	1,288,071	6.8
Ferreira	324,603	8.13
Ferreira Deep	1,837,808	9.7
Geldenhuis Deep	2,262,840	6.2
Modderfontein B.	2,355,700	7.5
New Modderfontein	3,341,830	7.6
Nourse Mines	2,050,705	6.6
Robinson ... 1,221,661	—	11.4
305,000*	—	—
1,307,133	—	4.2
	2,833,794	
Rose Deep	3,670,160	6.0
Village Deep	2,159,792	6.1
Village Main Reef	1,775,175	9.2
Totals	36,999,442	

*Estimated tonnage recoverable from old workings, etc.

Companies with head offices in Natal, managed by the Central Mining and Investment Corporation—

	Tons.	Dwts. per ton.
City and Suburban	789,084	7.6
New Heriot	569,716	8.4
Totals	1,358,800	

Consolidated Gold Fields of South Africa, Ltd.—

	Tons.	Dwts. per ton.
Jupiter	1,089,000	5.74
Knights Deep	1,650,000	5.2
Luipaardsvlei Estate	432,000	5.2
	142,000*	5.3
Robinson Deep	1,140,000	7.2
Simmer Deep	1,312,000	4.9
Simmer and Jack Proprietary.	2,500,000	6.4
Simmer and Jack East ...	934,000	5.4
Totals	9,199,000	

*Part developed.

Farrar Group—

	Tons.	Dwts. per ton.
East Rand Proprietary ...	6,716,605	6.9

Anglo-French Group—

	Tons.	Dwts. per ton.
Benoni Consolidated	606,839	6.56
New Kleinfontein	1,146,531	7.49
Totals	1,753,370	

General Mining and Finance Corporation—

	Tons.	Dwts. per ton.
Aurora West	345,578	5.85
Cinderella Consolidated ...	740,157	6.73
Van Ryn	1,655,910	6.37
Meyer and Charlton	312,336	10.099
New Goch	962,575	5.06
Rand Collieries	374,200	5.375
Roodepoort United	448,800	5.49
West Rand Consolidated ...	1,003,000	5.25
Totals	5,842,556	

S. Neumann and Co.—

	Tons.	Dwts. per ton.
Consolidated Main Reef ...	516,890	6.7
Knight Central	644,300	6.04
Main Reef West	628,260	7.0
Vogelstruis Cons. Deep ...	149,530	5.9
Witwatersrand Deep	1,436,202	6.79
Wolhuter	808,780	6.45
Totals	4,183,962	

Johannesburg Consolidated Investment Co.—

	Tons.	Dwts. per ton.
Consolidated Langlaagte ...	1,619,647	6.7
Ginsberg	367,646	6.8
Glencairn	925,000	3.5
New Primrose	423,311	6.7
New Rietfontein	361,484	6.1
New Unified	288,343	6.73
Van Ryn Deep	603,716	7.17
Witwatersrand	1,225,084	5.65
Totals	5,814,231	

The Randfontein-Langlaagte Group—

	Tons.	Dwts. per ton.
Langlaagte Estate	1,281,307	—
Randfontein Central	5,658,859	7.24
Totals	6,940,166	

A. Goerz and Co.—

	Tons.	Dwts. per ton.
Geduld Proprietary	607,300	8.18
Lancaster West	472,700	6.65
May Consolidated	212,707	6.84
Princess Estate	656,500	7.26
Totals	1,949,207	

Consolidated Mines Selection—

	Tons.	Dwts. per ton
Brakpan Mines	1,925,346	6.73

RAND MINING IN PICTURE



South Rand Shaft, Crown Mines, Limited

The Messina (Transvaal) Development Co., Ltd.

Early History :: The Position of the Mine Reviewed to Date :: Future Policy of Operations :: Railway Extension to Messina

By J. M. CALDERWOOD, M.I.M.M.

IN the Zoutpansberg District, Northern Transvaal, and immediately south of the Limpopo River, which divides Rhodesia from the Transvaal, lies an immense granite area. In this formation occur numerous groups of old workings, which would indicate that this section had at one time been the scene of a considerable active industry in the mining and smelting of copper ores by native workers. The farms Berkenrode and Vogelzang especially are remarkable



Messina, Northern Transvaal.

for the great number and extent of these workings, probably the largest known in the country, and the age of which it is impossible to say.

The existence of ancient workings scattered throughout South Africa has been known for many years, and those in the Northern Transvaal were discovered by early hunters and prospectors, but it was not until 1902, after the termination of the Boer War, that active prospecting operations were attempted. At that time the region in the neighbourhood of the Limpopo River was looked upon as a death-trap to white men, owing to malarial fever being prevalent during the rainy season; the country was infested with wild animals and but few natives lived in that section. There were no roads, water was scarce, travelling and transport difficult owing to dense bush, and the nearest base for stores and supplies, by the only available route, was the town of Pietersburg, the northern terminus of the Central South African Railways, about one hundred and forty mlies south of the copper field.

To Mr. John P. Grenfell belongs the credit for the first expedition sent to the Messina district, on the strength of vague reports regarding the extent and locality of the old copper workings.

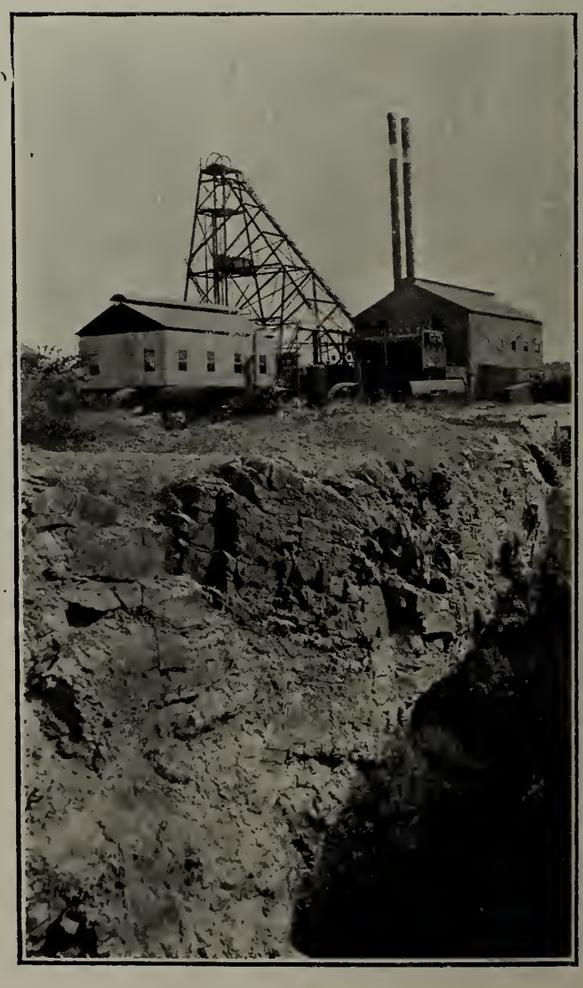
Grenfell Camp.

Since Grenfell Camp was established, many difficulties have been overcome, and but for the faith and tenacity of those interested in the venture, the district might still have been an unknown wilderness.

The pioneer company, namely, the Messina (Transvaal) Development Company, Ltd., now occupies the position of a prominent and steady copper-producing concern, practically the only one in the Transvaal.

There is now a well laid out camp with substantial buildings, gardens, good roads, tri-weekly post-cart service, and generally good health conditions, which it is safe to say will compare favourably with any other outside mining camp in South Africa.

The white population numbers about seventy-five, and there are about five hundred natives employed.



Messina Mine, Main Shaft.
Old working in foreground, in Bonanza Lode.

The underground and surface equipment at the Messina mine, for the mining and treatment of the copper ores, is of up-to-date order. All machinery and material for the mine has been transported by donkey-wagons from railhead, the bulk of it over the high Zoutpansberg, since the opening of the Government road viâ Louis Trichardt, a distance of one hundred and thirty miles. Prior to this, the route was about thirty



Messina Mine, Concentrator.

miles longer, viâ Brak River, to the west, through a flat, bush-covered, and totally uninhabited country.

At the present time the company's operations are concentrated to an area on the farm Berkenrode. Their total holding amounts to 22,432 acres, and the possibilities for several other mines, especially on Vogelzang, are apparent from the satisfactory results obtained by preliminary work done on the copper lodes and the evidence of the extensive old surface workings, of equal importance to those already opened at Messina. With the exception of the area in the immediate vicinity of Messina and the recent discoveries at the Matale copper field, about seventy miles to the east, the Northern Transvaal remains practically unexplored.

The Copper Lodes.

The principal geological features of the district are granite, gneiss, and schists, with masses of quartz and hornblende. The copper-bearing belt or zone is characterised by lines of fissuring, and the chief discoveries of copper-bearing lodes so far are confined to the lines of old workings that generally follow the shear-zones, and have been traced at Messina, running about north and south, for over fifteen miles. The copper occurs mineralised as carbonates and sulphides, chiefly glance, bornite, and chalcopyrite.

The lodes run about parallel, and the distribution of the ore is somewhat irregular; rich shoots occurring along the strike extending over one hundred and fifty feet in length, with intervening zones of lean or barren ground. The width of the ore bodies varies in size from a few inches of compact ore up to thirty feet or more, with very rich masses of practically solid copper mineral, that have been found extending continuously in depth from level to level without showing any decrease in width or value.

The main three-compartment shaft has been sunk to a vertical depth of 818 feet. The principal ore shoot—known as the Bonanza—was intersected by this shaft at a depth of 764 feet, and continued in solid ore to the bottom. For the last 54 feet sunk, the average assay value was 22 per cent. metallic copper for an average sample width of 72 inches. In the station crosscut at the eighth level the lode proved to be 27 feet in width and assayed 17 per cent. copper. The ore exposed by a drive along the hanging wall portion, on this level, assayed 18 per cent. copper over 60 inches for a distance of 120 feet. Three lodes are being worked, the north lode, which has so far proved to be the best ore carrier, has been developed by continuous drives in a direction along the strike for over 1,500 feet.

The average assay value of the mine is 10 per cent. copper, according to assay plans, and this has been confirmed in a practical manner by the results obtained from the ore mined and milled to date. The total amount of work done throughout the mine by drives, crosscuts, winzes, and shafts is over 23,000 feet. Since January, 1906, to December, 1912, the company has produced and shipped to Europe 10,300 tons of copper concentrate averaging over 50 per cent. copper content, derived from the local treatment of ore. The above production has realised a gross value of approximately £265,000. It is estimated that the average assay value of all ore treated during the period, amounting to 71,745 tons, was about 12 per cent. copper.

Mining Methods.

The methods of mining the ores are such as are usually employed for almost vertical lodes of this kind. Levels are driven, following the lodes, at each hundred feet in depth, with suitable winze connections between levels. Where the lodes are narrow, the ore is extracted by overhand stoping, and gravitated to the chutes for tramming. The walls, as a rule, are strong and require but little timbering.

In the wider portions of the lodes, such as the Bonanza, where the ore has to be worked out up to twenty-five feet in width, the "slicing" method is employed—that is, a cut is first made from the level through the ore body from wall to wall, and the space is packed with waste rock. A succession of cuts is then made and similarly packed, until the area has been mined. The next series of cuts is then made overhead and packed, and so on until the level above has been reached. Ore passes of cribwork are carried up simultaneously with the progress of ore extraction, and waste rock from surface is sent down through the winzes for filling purposes. In the lower levels, the main drives are being laid out straight and the lode tapped by box holes, for greater convenience in tramming and providing better security with less requirements for timbering and maintenance.

No provision has to be made to guard against the evils of dust owing to the nature of the rock, and



No. 3 Shaft, Messina Copper Mine.

efficient natural ventilation is secured by simple methods of controlling and directing the air currents. From 50,000 to 100,000 gallons of water per day are pumped from the mine, depending upon the season and the water encountered during development. The water is entirely suitable for boilers and milling purposes and is non-acid, owing to the high percentage of lime. For domestic purposes, a good water supply is obtained from wells.

Ore Reserves.

At the end of December last, the ore reserves throughout the mine were calculated at 121,000 tons, estimated to contain an average of 10 per cent. copper for ore developed and partially developed to eighth level. The probable ore was placed at 265,000 tons, and for possible ore down to tenth level another 120,000 tons.

With the benefits to be conferred by railway connection, the above tonnage, when fully developed and the milling capacity increased to 12,000 tons per month, it is estimated that profits equal to about £150,000 per annum will be realised, basing the market price of copper at £55 per ton.

Railways.

The question of railway facilities is all-important for the future success of the Messina mine. The extension of the railway line from Pietersburg to the north was opened for traffic last year as far as Bandolier Kop, thereby placing Messina within a distance of seventy-five miles from railhead. The next section will be opened to Louis Trichardt within the next few months, and construction will proceed right on to Messina, viâ Zand River Poort, whereby an all-rail connection between the mine and Delagoa Bay will be established some time next year.

The line from Messina to the north will doubtless be linked up in time with the Rhodesian railway system, which at present comes as far south as West Nicholson,



Headgear under Construction, Messina Copper Mine.

about one hundred and ten miles from the Transvaal border.

Since the railway was opened between Pietersburg and Bandolier Kop, the train service has been increased from two trains per week to a daily train, as found necessary to cope with the traffic. There can be no doubt that this section of the line is highly payable, and should have warranted its construction for some years past instead of at this late date.

Future Policy.

The future policy of the company's operations has been carefully considered in order to place the mine in readiness for railway communication, and development is being vigorously proceeded with. Since July of last year stoping of ore has been suspended and production has been limited to sufficient tonnage to give transport riders bringing up material and supplies return loads to railhead. The mill is, therefore, being run on ore obtained entirely from development work. A new shaft will be sunk in line with the present main shaft, about fifty feet away, so that ample provision will be made for increased milling operations. New concentrating plant, for which the designs have been prepared, will be erected at the twin shafts, comprising two units of 250 tons each daily capacity, arranged on the most up-to-date lines for the treatment of copper ores.

Coal.

The present mill power is supplied by a suction gas plant using locally-made charcoal, but in view of the discovery of coal in the neighbourhood of the mine, large additions to the boiler plant will be made and a central electric power station will be equipped for the distribution of power for future requirements. The coal field lies about fifteen miles south-west of Messina,



Poort. Road to Messina.

on the farm Rotterdam, over which the new railway will pass, and this important discovery will constitute an important factor in the company's future operations. Analyses of the coal are so far satisfactory, and the development of the seam promises well for workable coal of fair quality being obtained.

Financial.

The nominal capital of the company is £250,000, divided into 5s. shares, and of the total 1,000,000, only 661,804 are in issue and fully paid. An issue of £250,000 of six per cent. debenture stock has recently been arranged at the price of £95 per cent., and on this the interest is guaranteed for a period of five years. The company is therefore in a strong financial position, with ample funds for the prosecution of necessary development and for the erection of adequate milling and surface plant commensurate with the scheme laid down for future operations when the railway reaches the mine.

RHODESIAN MINING IN PICTURE



Giant Mines, Rhodesia

Financial Position of Messina Copper

A Brief Review of its Outstanding Features

THE financial position of the Messina Copper Company has been laid down on the same bold and broad lines that has marked the mining development of the property. On the preceding pages an able article on the latter appears from the pen of Mr. J. M. Calderwood, the consulting engineer of the company. Mr. Calderwood's excellent article, however, may be supplemented by a brief account of the finances of the company supplied to us by Mr. Charles Stuart, their local representative. The Messina (Transvaal) Development Company, Ltd., was incorporated under the Companies (Consolidation) Act of 1908. The share capital is £250,000 divided into 1,000,000 shares of five shillings each, of which 661,804 are issued and fully paid; the balance of 338,196 shares are still in reserve. There is in addition a six per cent. debenture issue amounting to £250,000, which has been taken up and which carries the right to the purchasers of the issue to subscribe at any time before June 30th, 1916, for all or any part of the 338,196 reserve shares at twenty shillings per share, and the purchasers in turn have offered £183,000, part of this issue, for public subscription, carrying the right to the subscriber to subscribe at any time up to March 1st, 1915, for one share of five shillings in the capital of the company at twenty-two shillings and sixpence per share in respect of each £2 of debenture stock allotted to him. The interest on the debenture stock for five years from January 1st, 1912, is unconditionally guaranteed by Camp Bird, Ltd.

The gilt-edged nature of the security is shown by the fact that, with the completion of the new mill and works, the annual profit resulting from the milling of one hundred and twenty thousand tons per annum should be £184,464, taking best selected copper at £60 per ton (the present price being over £74 per ton), or twelve times the amount required to pay the interest on £250,000 six per cent. debenture stock, i.e., £15,000.

The security for the above £250,000 debenture stock may be briefly summarised as follows: It was estimated at June 30th, 1911, that the positive and probable ore reserves to the eight hundred-foot level amount to approximately 430,000 tons, which, after sorting, would amount to 350,000 tons of ten per cent. ore. The estimated profits on this tonnage, taking copper at £60 per ton for best selected copper (whereas the present price is over £74 per ton), amount to £640,000; there were 6,500 tons of thirteen per cent. ore middlings awaiting railway, £30,000; the Vogelzang properties, the surface workings of which show very large bodies of ore-bearing ground (at cost), £35,000; the machinery and plant already installed, £30,000; fourteen thousand acres of freehold land and coal field, £5,000; making a total of £740,000.

These valuations are based on the future profits of one mine alone out of four large proved deposits belonging to the company, in all of which exploratory shafts have disclosed the presence of ore bodies equal in value to those already developed. Should the remaining portions prove on development to be of equal value to the mine already opened up, the company will be in possession of not merely one mine, but a copper field of great magnitude. The proceeds of the last successful issue of debenture stock are being applied in furnishing the company with additional working capital to further develop and equip the mine and enlarge the present mill capacity to one hundred and twenty thousand tons per annum, and establish smelting works, hitherto postponed owing to the lack of adequate transport facilities.

COAL MINING IN THE TRANSVAAL



A Day's Output at Witbank Colliery

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Combines the following TRIPLE BENEFIT: *(a)* **£1,000** at death of Assured; *(b)* **£100** per annum **for 20 years thereafter**; *(c)* **£2,000** in cash at the end of the 20 years.

Annual Premium at age	25	next birthday-	£63	12	7
" " "	30	" " -	71	6	0
" " "	35	" " -	82	2	7
" " "	40	" " -	97	9	5
" " "	45	" " -	117	6	6
" " "	50	" " -	143	13	0
" " "	55	" " -	178	7	11

EXAMPLE:

At age 30 the "Expectation of Life" is about 35 years. If, therefore, the Policyholder lives to 65 he will have paid in Premiums - - £2,495 10 0
The Benefits under the Policy total - - - 5,000 0 0
DIFFERENCE - - - £2,504 10 0

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Life Insurance

General Review and the Case for the "Foreign" Office

(Contributed)

AS in insurance a plea is often made for local companies, the following article—apart from a general review—is the view from a non-local standpoint. Broadly, this journal commends all life insurance apart from national prejudice, nevertheless it is interesting, and perchance it may be profitable, to survey the question from different points of view.

The period under review, since the first publication of this journal in 1891, has witnessed a healthy growth in life insurance, and, it may be said, events have made for the betterment of conditions generally. If, years ago, the now threadbare dictum was admitted that "nothing in the commercial world approached, even remotely, the security of a well-established life office," recent legislation in Europe, in the United States, and in Canada has rendered assurance doubly sure. Such legislation evinces the recognition by the State of the responsibilities of those administering the affairs of insurance companies, as well as the international nature of the interests involved. For instance, German laws bind and regulate the actions of a company licensed in that State in its operations the world over.

In 1891 there were only fourteen companies transacting life insurance business in the Transvaal, as against twenty-nine at the present time. These comprise seventeen British offices, three American, two Colonial, one European (other than British), one Canadian, and five South African companies. One of the last-named class, The African Life, was founded in Johannesburg in 1905, and, judged by its policy contracts and up-to-date methods, may be regarded as not the least progressive of its kind.

According to Parliamentary returns, the principal totals for British life companies reporting to the London Board of Trade during the last two decades were as under :—

Blue Book, Year of issue.	No. of Comp'nies	Total Funds.	Total Premiums.	Insurance in force.
		£	£	£
1891	91	165,809,134	14,213,386	443,362,228
1901	85	240,688,985	21,259,186	616,911,783
1911	86	341,084,344	29,402,259	782,198,531

Absorption and consolidation has been the order of the day. Regarding the nature of the business written, the older and simpler form of insurance has given way to more varied methods, and, during the whole period under review, there has been a steady increase in the percentage of "limited payment" and "endowment" insurance issued.

Below we give a list of all the companies licensed in the Transvaal, together with figures which indicate the size and vitality of the respective offices. We have classified the companies as "home" and "foreign"—the latter group including British, European, Colonial, and Canadian. The American offices being a class apart, and for other reasons hereafter noted, are treated separately. The figures are for 1910. As the Board of Trade returns issued this year are not yet to hand, and as many companies have only furnished us with their 1911 reports (containing previous years' figures), for uniformity's sake we have in all cases given totals for the year mentioned.

	Total Funds.	New Business.	Premium Income.	Percentage of expenses to Premiums*
HOME†	£	£	£	
African Life	120,017	1,001,875	78,423	55·5
S.A. Mutual	4,891,074	1,364,250	427,648	17·4
Southern Life	701,907	757,752	140,152	22·2
FOREIGN.				
Alliance	6,529,376	1,471,308	583,595	9·7
Caledonian	2,893,137	673,155	254,396	14·6
Col. Mutual (Australia) ...	3,219,446	2,598,247	421,535	27·2
Commercial Union ...	4,349,572	1,913,116	485,585	12·5
Eng. & Scottish Law Life	2,851,296	485,299	218,823	17·5
General Life	2,192,033	396,010	187,748	19·8
General Life Ass. Corp. Ltd.	65,602	188,430	24,303	17·8
Gresham	10,216,844	2,196,001	1,036,631	21·6
Law Union and Rock ...	7,611,359	1,094,334	586,341	14·8
London and Lancashire ...	2,591,262	623,456	318,358	20·2
Manufact'rs Life (Canada)	2,567,065	1,899,959	488,368	27·7
Mutual Life Ass. Bank Stuttgart	17,921,186‡	3,894,820	1,876,692	8·2
National Mutual of Australasia	6,194,633	3,267,437	800,149	21·0
North British & Mercantile	15,645,125	2,328,600	1,107,569	13·7
Northern	5,040,555	478,780	282,162	10·0
Norwich Union	9,853,950	5,585,785	1,295,569	16·2
Royal Exchange	3,987,603	1,048,380	313,609	16·6
Scottish Widows	20,240,396	2,373,470	1,258,509	10·3
Standard	12,658,288	1,850,644	999,408	19·3
Star	6,752,602	761,268	506,178	14·6
Yorkshire	1,996,331	600,120	163,152	14·9

*In comparing expense, ratios allowance should be made for total new business written. Large new business increases the percentage of expenses.

†The "Federal" and "African Homes Trust" have been omitted as in almost all respects it would be misleading to make comparisons between the older established companies and such small and youthful offices. The African Life though young has been included on account of its vigorous growth. Allowance should also be made for this latter company's recent origin when comparing expenses.

‡Gross Assets.

In 1891, the Equitable and the Mutual Life were the only American offices represented in the Transvaal. In 1904, they were joined by the New York Life. In February, 1905, owing to the Equitable having outgrown its original constitution, internal differences arose amongst its executive over matters of administration. The quarrel assumed such proportions and attracted so much public attention that a joint committee of the Senate and Assembly of the State of New York was

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appointed to investigate the affairs, not only of the Equitable, but of life insurance companies generally within the State of New York. In February, 1906, the Armstrong Committee (so-called after its chairman) presented its report, which resulted in the promulgation of drastic insurance laws during the session of that year.* Unhealthy tendencies were checked, and the general system of insurance so organised that, notwithstanding the serious nature of the irregularities exposed in connection with some of the offices, the convulsion proved a blessing in disguise. It should be added that, though abuses were unearthed—relatively small to the size of the offices concerned—the stability of the companies was never in question. In view of the circumstances above alluded to, in addition to a comparison of the figures of twenty-one years ago with those of to-day, we give the figures of the three American offices doing business locally, from 1905:—

EQUITABLE OF UNITED STATES.

	Total Funds.	New Business.	Premium Income	Percentage of Expenses to Premiums.
	£	£	£	
1891	28,245,120	38,418,729	6,832,064	24·9
1905	85,400,325	29,066,468	12,102,865	23·2
1906	88,248,003	17,127,013	11,523,669	17·8
1907	87,716,603	15,058,945	10,980,019	18·6
1908	94,634,966	18,754,362	10,639,583	20·0
1909	97,724,322	22,798,790	10,684,728	20·6
1910	98,705,951	22,888,821	10,744,948	20·1

MUTUAL LIFE OF NEW YORK.

	Total Funds.	New Business.	Premium Income.	Percentage of Expenses to Premiums.
	£	£	£	
1891	33,156,995	27,234,512	6,118,059	24·3
1905	95,847,702	37,302,391	12,364,242	25·5
1906	100,701,692	17,935,787	11,529,355	18·8
1907	100,205,146	10,004,117	11,168,113	15·7
1908	109,415,843	19,286,856	11,800,144	14·4
1909	113,634,667	20,952,922	10,683,677	16·9
1910	116,094,187	24,228,014	10,738,524	17·3

NEW YORK LIFE.

	Total Funds.	New Business.	Premium Income.	Percentage of Expenses to Premiums.
	£	£	£	
1891	25,651,865	23,360,065	5,024,376	27·7
1905	88,312,036	60,955,688	17,200,350	21·5
1906	96,370,165	34,508,639	16,646,681	16·8
1907	100,305,031	27,905,000	16,278,139	13·4
1908	112,686,989	28,641,673	15,977,686	14·7
1909	121,089,139	30,009,740	15,973,930	13·9
1910	128,886,724	32,294,668	16,407,361	14·6

The shrinkage in new business since 1905 is due to the restrictive legislation which not only limited expenses, but provided that from 1907 onwards the new business of no office should, under any circumstances, exceed one hundred and fifty million dollars (about £30,800,000). It may be remarked that already this particular restriction has been recognised as oppressive, and though expenses are still restricted, upon certain conditions in 1910 the $150,000,000 limit was extended.

Since 1891 the standard for valuation of policy reserves has in many cases been raised. In other words, the rate of interest assumed in calculating liabilities, present and prospective, has been lowered. British companies still continue to fix their own standards, mostly three per cent. Of those in the above list, two companies use a three and a half per cent. standard, and three value on a two and a half per cent. basis. The American standard is fixed by law at three and a half per cent. (the same rate which the Canadian Government assumes in its valuations), which is a standard well below the rate of interest realised in that country, but some of the offices in the United States have voluntarily adopted the more stringent three per cent. basis. South African companies for long past have valued at four per cent., although their interest earnings are now down to the level of companies adopting the stricter methods. The South African Mutual has just adopted a three and a half per cent. rate, which some friendly critics consider even yet too high. The interest earned on insurance investments still rules higher in Canada and America than in Great Britain, but as the British companies have taken to investing in these countries, the difference in favour of American offices is not now so marked. The chairman of the Scottish Widows' Fund in 1896 declared that, with the exercise of due care, that company would be able to find in the United States good investments to yield from one-half to one and a half per cent. more than investments of the same class in Britain, and (as such investments were usually terminable obligations redeemable at par) that without incurring the risk of loss by shrinkage of capital value. Sir Henry Cook, chairman of the same company, so recently as March this year, in speaking of the "geographical system" of investments, said: "I may say that the directors had practically adopted that system long before it was advocated in the public press. That is to say, they have made it their endeavour to spread the funds of the society over as wide an area as possible. If," he said, "we had confined our investments to this country, the return from them would unquestionably have been comparatively small, but by placing our money in investments in the colonies and in foreign countries, which provide equally good security, we have been able to obtain a rate of interest from one-half to one per cent. greater than the yield from corresponding Home investments." At the present time the Scottish Widows has about £5,000,000 invested in America, while last year its chairman gloried in the fact that about one-half of the society's investments were placed in securities which were outside the United Kingdom, or with companies which, though domiciled in the United Kingdom, have their investments out of it.

A study of the question of interest earnings since 1891 reveals interesting and notable features. With ever-increasing facilities for inter-communication and exchange, and with the merging of the world's interests, a tendency towards a common rate to be earned in the future on gilt-edged securities is beginning to manifest itself. In the present state of political and social unrest the world over, no question is of greater importance in consideration of future life insurance profits than the nature of securities held by the respective companies. Lapse ratios (now that surrender values are given by almost all offices) are increasingly unimportant. Death rates (where the averages are drawn from large numbers and wide fields) are approximating a uniform ratio. The force of competition will tend to average expenses, while, on the other hand, the matter of interest on investments will be liable to considerable variation, and will be a factor which will largely determine future profits in the event of financial upheavals or commercial crises. However, by the gilt-edged nature of securities held by conservative offices, it is the interest, alone, that will be appreciably affected. The stability of insurance offices in general is sometimes questioned by the ignorant. When such investments as insurance companies possess become seriously affected by adverse circumstances, all else in the financial world will have gone by the board.

Broadly and generally, during the last twenty years, after a decade of gradually decreasing rates of interest earned on insurance investments, the lowest point was reached about the year 1902, from which time the rate

* Following the amendment of the insurance laws in the United States in 1906, amendments were considered in the Canadian Parliament during 1907-8 resulting in the adoption the following session of the law known as "The Insurance Act, 1910." The British Parliament added to its statutes the "Assurance Companies Act, 1909." However, a comparison of the provisions contained in the laws of Austria, Germany, Switzerland, for instance, or of the American and Canadian laws with the existing British Law reveals the fact that the Board of Trade control is of a most shadowy nature.

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has steadily increased to the present day. The interest now earned by South African companies, speaking generally, is not higher than that of British and American offices. During the last few years the rate realised by the "foreign" offices above named has shown a slight increase, while that of the South African companies exhibits a downward tendency.

As a general principle, all else being equal, we incline towards South African institutions. But this proposition brings us to the root of the matter. In the question at issue things are not equal. Insurance is based on averages. And whether it be investment, mortality, lapse ratios, or other factors determining eventual results, local offices, in the long run, are placed at a disadvantage, being dependent upon, and so much more largely affected by, local conditions. In the matter of interest earned on investments, if we compare the rate earned by the older-established local offices with that of the large British or American companies, whether we take the yearly variation or the variation over periods of years, the fluctuations in the case of the local offices are strikingly apparent. Indeed, it is the absence of the principle embodied in the "geographical system of investment," coupled with the comparative instability of conditions, which has occasioned such a large writing down of the investments of local offices during the period under review. Similar variations are apparent when we compare the yearly percentages of death claims to premium income in the cases of local offices and those transacting business over wide fields. Whereas, in the case of the latter, the ratio often does not vary one per cent., with the local companies the yearly fluctuations are four or five times as great.

Objection is sometimes urged that the "foreign" offices take money out of the country, but with such companies the tendency, after they have been some time in the country, is for the payments returned to policyholders in the shape of death claims, money spent in the country, and loans to policyholders, to approximate the premiums received. As against any difference between the amounts received from, and paid to, the people of South Africa, the "foreign" companies can point to the employment of many South Africans in their service, to the buildings they erect in our midst, and to the advantages which have accrued to the public as a result of the competition they have provoked. But more than this, the opportunity is afforded South Africans to avail themselves of the best the world can offer, and this at rates of premium identical with those charged in older, more settled, and also cheaper-living countries. And as the majority of so-called "foreign" offices issue covering policies and pay claims locally, they may be said to offer the advantages of local institutions, while as regards important information and details of interest to policyholders, owing to Government supervision exercised in Canada, America, and some of the countries in Europe, fuller particulars are to be obtained about many of the "foreign" companies than of those of local origin!

In the case of some "foreign" offices, safeguards, too, exist in the way of statutory requirements regarding the computation of liabilities, the assessment and investment of assets, the nature of investments permitted, and even regarding the conditions and wording of their policy contracts. Not only may it be said that non-local companies are in many respects preferable, but that on general principles, all else being equal, the company which is most cosmopolitan in its operations and investments is the ideal. In short, the boast of local offices that they are purely South African, have all their investments in this country, and so on, is the very thing which should make the thinking man pause who is about to enter into a contract which may possibly extend over half a century, and should make him thankful, in a business where the interests are so interdependent and complex, that free trade principles prevail. Insurance being based on averages, it follows that the broadest basis is the most stable. With reasonable limitations to prevent abuses, wide and free competition, and publicity will ever prove safeguards ensuring security and efficiency. In such a case the big idea is preferable to the small, the cosmopolitan to the local.

* Quite a number of companies have even adopted bilingualism in their literature. The following Companies issue policies in Dutch:—African Life, Col. Mutual, Equitable, U.S., New York Life, South African Mutual, and Southern.

The Man who Refuses to Listen to the Voice of Wisdom

and declines or neglects to consider what his position may be in future years is deliberately creating a heavy burden which he may have to carry to the end of his days. A little self-denial now while young and able to earn may mean in later years the difference between comfort and poverty.

INSURANCE

is the easiest, cheapest and most profitable means of saving money

We have special schemes to suit all circumstances

PLEASE ADDRESS:

BULLEN BROS.

GENERAL MANAGERS,

THE STAR ASSURANCE SOCIETY,
95, Commissioner Street, Johannesburg

P.O. BOX 489 TELEPHONE No. 403

Accidents & Sickness will happen

Numbered amongst the best types of Accident Insurance Policies issued is that of the

London & Lancashire Fire Insurance CO., LTD.

It is one of the very best and there is none better.

LIBERAL POLICIES
are what are required and the Company are prepared to supply the want.

Departments: Fire, Personal Accident, Sickness, Workman's Compensation, Motor Car, Fidelity Guarantee, Court Bonds, Burglary, Registered Post, &c.

BULLEN BROS., Accident Managers for South Africa

G. CAWOOD HOBSON, Accident Superintendent for the Transvaal

London & Lancashire Fire Insurance Co., Ltd.

95, COMMISSIONER STREET, JOHANNESBURG.

P.O. Box 489 Telephone No. 403

Southern Life Association

1912 BONUS YEAR 1912

As showing the progress made by the Association

FUNDS

1891
£3,729

1897
£79,000

1904
£289,000

1911
£818,000

(MUTUAL) *(SOUTH AFRICAN)*

For Life, Accident, Sickness and Employers' Insurance

THE POLICY-HOLDERS ARE THE SHAREHOLDERS
They control the Association and receive all the profits

Special 'Southern' Policies

"Double Benefit"
"Guaranteed Option Investment"
"'Favourite' Accident and Disease"
"All Sickness"

And, JUST ISSUED,

CHILD'S DEFERRED ASSURANCE

(NO MEDICAL EXAMINATION)

EXAMPLE:

Annual Premium - - £12 0 0

Child born 1st December, 1911 (Age next birthday, 1 year), Policy effected 1st June, 1912.

At the end of twenty years (1st June, 1932) the Child secures (without Medical Examination) a Policy of Assurance for £1,355 (With Profits) payable at death, subject to continued payment of the above Premium. *(N.B.—For a similar Policy at that age, but subject to Medical Examination, the Annual Premium would be £25 9s. 3d.)*

Should an Assurance not be desired the Parent or Guardian may obtain a cash payment of £351. *(N.B.—The total Premiums paid amount to £240);*

Or, he may select on behalf of the Child, any one of the other six options stated below which have been framed to meet any alternative likely to be desired.

OPTIONS

If Payments are Continued:

(1) WHOLE LIFE ASSURANCE for £1,262, with profits, premiums ceasing at age 50
(2) " " " " £1,316, " " " " 60
(3) ENDOWMENT ASSURANCE for £987, with profits, payable at death or age 50
(4) " " " £1,206, " " " " 60

If Payments are Discontinued:

(5) PAID-UP WHOLE-LIFE POLICY, for £894, with profits
(6) " " " " £1,041, without profits

Chief Office: SOUTHERN LIFE BUILDINGS, CAPE TOWN
(P.O. Box 42)
Branch Offices and Agencies throughout South Africa

The Southern Life Association

IT is an interesting coincidence that the "majority" year of the "Southern" should synchronise with the "majority" year of the "South African Mining Journal," and it is, therefore, fitting that the birthday number of the journal should contain a special notice of this purely South African life office, which has also successfully faced the vicissitudes of the past twenty-one years.

The story of the birth and up-rearing of the "Southern" has often been told, and except perhaps on exceptional occasions such as these, does not need



Head Offices, Cape Town.

to be retold, for the man does not want always to be talking of his childhood days, and the "Southern," having come of age, is naturally more inclined to look forward than to look back, to indulge in imagination rather than in retrospect.

Suffice to say, that in January, 1891, there appeared for the first time on the insurance horizon in Capetown a small, bright, particular star, which, observed at first by only a very few, gradually gained in size and brilliancy until it forced itself not only upon the attention, but also upon the admiration, of the whole of the insuring public of South Africa.

The man behind the star was William Elliott, to whose experience, energy, and enterprise, supported by a sympathetic corps of directors, the star owes its origin and its present size and position and brightness in the insurance heavens. In astronomical language—if we may indulge the metaphor a little longer—it is in the "right ascension," but a very long way yet from the zenith, which appears constantly to recede as the star ascends, which is only a figurative way of saying that no one can foretell the ultimate bulk and influence and beauty of this solid and luminous body, which moves and shine and exerts its beneficial influence in the southern hemisphere.

When the office doors of the "Southern Life" were first opened in January, 1891, the office had no policy-holders, no capital, no funds, no premium income, no agents, no record of past achievements. It was not even born in prosperous times—financial troubles abounded, and made the difficult task of successfully establishing a new venture more difficult still. The only thing the office had to boast of was the quiet determination of a small body of men, who, having put their hands to the work of rivalling the only other South African life office then extant, could not be turned from their purpose nor denied the just reward of their endeavours.

But although the "Southern" started with nothing, by the end of the first year it had received nearly £10,000 in premiums, and had saved nearly £4,000 in funds, after paying all commissions, claims, and expenses, including establishment charges, all of which latter were, contrary to the usual practice in such cases, charged to and completely liquidated in the first year's accounts, instead of being spread over a number of years.

Since then the growth of the "Southern" has been continuous and without setback, except during 1900, when all life offices suffered alike from the effects of war. The following statement will sufficiently indicate the rate of gradual progression which, as it has been continuous for twenty-one years, may surely be relied upon to continue for unlimited decades :—

	Total Income.	Total Funds.	New Life Policies Written.	
December 31st,				
1891 ...	£9,330	£3,729	350	£126,875
1892 ...	22,268	15,081	606	242,925
1893 ...	31,138	16,216	648	252,175
1894 ...	34,203	26,155	636	255,250
1895 ...	38,368	39,526	629	260,275
1896 ...	49,628	58,183	727	287,200
1897* ...	52,819	79,191	649	256,425
1898 ...	56,497	99,763	693	281,100
1899 ...	58,644	120,058	639	229,800
1900† ...	52,075	140,487	150	65,600
1901 ...	63,318	156,053	561	244,317
1902 ...	77,050	191,410	733	304,218
1903 ...	93,764	233,585	1,148	475,950
1904‡ ...	112,130	289,099	1,406	562,700
1905 ...	126,912	345,412	1,719	600,925
1906 ...	146,713	412,441	1,915	686,300
1907 ...	157,962	470,761	1,914	648,800
1908 ...	169,863	543,898	1,728	650,457
1909 ...	177,975	620,994	1,693	603,414
1910 ...	200,534	720,439	2,128	757,752
1911§ ...	230,780	818,282	2,945	1,032,800

*Seventh year. †War. ‡Fourteenth year. §Twenty-first year.

The main justification for the establishment of the "Southern" as a purely South African office is perhaps contained in a statement of the Treasurer-General in his 1891 Budget speech, that, even at that time, the sum of £150,000 annually left these shores for foreign lands in payment of insurance premiums. This unnecessary exportation of minted gold has been lessened to some extent at any rate by the establishment of the "Southern," the whole of whose operations is confined to South Africa, and the whole of whose funds is invested here. Capital, therefore, one of the prime requisites especially of a young colony, is being kept in the country and used for manifold productive purposes—it circulates within the limits of the Union, and does not enrich any other country at the expense of our own.

No one can complain that South Africa does not afford the best of homeborn facilities for life assurance, and with the "Southern" at our very doors, a product as it were of our own country, there is no excuse to go to English or foreign offices for the protection that every man requires, whether he be a husband and father, whether he have business responsibilities upon him, or not. If a South African farmer produce good butter, for instance, as very many of them do, the interests of the country demand that that butter shall be bought and used in preference to butter from oversea. In the same way, if a South African office, such as the "Southern," offer good life assurance (as it undoubtedly does), the interests of the country generally, and of the individuals residing here, demand that those policies should be bought in preference to policies offered by offices from oversea. "Charity begins at home"—it is a good motto, and especially applicable to the present matter in hand.

We have already referred to the fact that the "Southern" first loomed upon the insurance horizon at a time when things were distinctly bad. We find the directors, in their very first report, saying: "These highly satisfactory results have been achieved notwithstanding that the association began operations in the midst . . . . of commercial depression"; and we find, at the second annual meeting, one of the members saying: "The directors have steered the association through one of the most violent storms that have yet assailed the financial institutions of South Africa." Not only did the "Southern" weather the storms which beat about it during the first year or two of its life, but it has as successfully weathered all the other storms by which it has in turn been assailed during the succeeding nineteen years—drought, pestilence, plague, and war—not to mention the ever-increasing competition from oversea, as well as from more recently established South African offices. Small wonder that, as it survived the early storms, it should have survived the later ones also. It seems to have attained to such strength, and to give evidence of such virility and energy, that one is led to the opinion that nothing can interfere with its continued advancement, nothing threaten its solidity and its permanence.

It is interesting to notice that three out of five of the original directors are still on the board, viz., Messrs. J. M. Stephen, Gus. Trollip, and John Forrest, and that Mr. William Elliott is still at the head of affairs as manager, thus securing continuity of policy and an uninterrupted historical grip upon the affairs of the office generally. The two original auditors still check the accounts.

The "Southern" has nine well-established branches as follows: Four in the Cape Province, where also the head office is situate; two in the Transvaal, one in Natal, one in the Orange Free State, and one in Rhodesia, and a staff of field men whose ability, industry, and devotion it would be hard to beat, and when such men have excellent contracts to sell, life, accident, sickness, and workmen's compensation, no wonder that things are still forging ahead. A few of the best contracts offered by the "Southern" may be briefly mentioned:—

Life Department.

In addition to the ordinary whole-life and endowment policies, there are the double-benefit investment policies (Table IV.). Example: A man aged twenty-five, for an annual premium of £32 19s. 2d., may secure £1,000, with profits, payable to himself at sixty years of age or to his heirs at his death, if earlier. In addition, on attaining the age of sixty, he receives a fully paid-up or free policy for £1,000, with profits, payable at death thereafter.

Child's Deferred Assurance.

(Table VI.b.).

Example: Annual premium, £12. Child born 1st December, 1911 (age next birthday one year) policy effected 1st June, 1912. At the end of twenty years (1st June, 1932) the child secures (without medical examination) a policy of assurance for £1,355, with profits, payable at death, subject to continued payment of the above premium. (N.B.—For a similar policy at that age, but subject to medical examination, the annual premium would be £25 9s. 3d.) Should an assurance not be desired, the parent or guardian may obtain a cash payment of £351. (N.B.—The total premiums paid amount to £240). Or he may select, on behalf of the child, any one of the other six options stated, which have been framed to meet any alternative likely to be desired.

Guaranteed Investment and Pension Policy.

(Table XI.).

Example: Policy for £1,000. Age thirty next birthday. Annual premium, £30 1s. 8d., ceasing at sixty years of age. £1,000 is payable in the event of

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RAND MINING IN PICTURE



The Comet Mine

death before the age of sixty. Guaranteed options at age of sixty: (1) An immediate cash payment of £1,075; (2) the policy to be continued for £1,000 payable at death, without payment of further premium, and an immediate cash payment of £465; (3) a pension of £104 12s. per annum for life, payable in half-yearly instalments; (4) subject to evidence of health, a policy for £1,702 payable at death, without payment of further premiums.

£2 Per Cent. Per Annum Guaranteed Reversionary Bonus Policy.

(Table XII.)

Twenty years endowment assurance. Sum assured £1,000, payable at the end of twenty years, or at previous death, with a guaranteed immediate bonus of £2 per cent. per annum. Age next birthday, thirty. Annual premium, £58 2s. 6d. At the end of twenty years the member has the option of taking: (1) sum assured and bonuses in cash, £1,400; (2) annuity for the rest of his life of £105 15s. 2d. yearly, £51 17s. 9d. half-yearly, or £25 14s. 2d. quarterly; (3) non-profit paid-up assurance payable at death for £2,525, subject to satisfactory evidence of good health.

With each annual payment of premium the sum assured increases, as do also the paid-up policy value and the loan and surrender values.

Accident and Sickness Insurance.

"Favourite" accident and disease policy, "All-kinds-of-sickness" policy, workmen's compensation insurance, etc.

Apply for prospectuses and full information to any of the agencies or branches, or to: Chief Office, Southern Life Buildings, P.O. Box 42, Capetown; or Johannesburg Branch, Trust Buildings, Fox Street, P.O. Box 1583.

203rd YEAR OF THE OFFICE

SUN FIRE OFFICE

(Founded 1710)

The Oldest Insurance Office in the World

Annual Income, 1910	:	:	**£1,674,837**
Funds in hand	:	:	**£3,105,071**

FIRE INSURANCES ACCEPTED AT LOWEST CURRENT RATES

Transvaal Branch: SAUER'S BUILDINGS, P.O. BOX 429, JOHANNESBURG
EDWARD T. ROBERTSON, Local Secretary

Chief Office for South Africa:

Sun Buildings, P.O. Box 128, KING WILLIAM'S TOWN

ALAN B. GORDON, Manager for S.A.

Life Assurance—
South Africa v. Oversea Offices

BY all means let us not be narrow, nor parochial, nor provincial—call it what you like; but, on the other hand, let us remember that our first duty is to the country in which we live rather than to that from which we may have come, to ourselves and to those immediately about us, who can reciprocate business and who expect us to do the same. Let us "think in continents" certainly, but as we are living in South Africa, let us think in the South African continent first of all, and not in the European or American continent. The country of our birth was a very good country, and some of us may sorrow that we ever left it, but leave it we did, for good or ill, and there seems but little chance of our ever getting permanently back there, even if we should wish to do so, and we have to make the best we can of the country we are in—to make the best of it and to do the best we can for it—and, therefore, directly and indirectly, for ourselves; and this is true still more emphatically to those who are South African born.

The particular application of these general remarks is to the question of life assurance with South African offices as opposed to life assurance with oversea offices, a most important question, involving as it does the permanent interests of this country in a way which is not sufficiently realised at the present time, but which, until it is realised, will help in the holding-back of this country in the paths of financial progress, and, therefore, in all other paths, industrial, commercial, and agricultural.

We are thankful that there are, and always have been, far-seeing men, friends of the country, who have perceived the truth that money sent out of this country to other lands in payment of commodities manufactured there is a very distinct detriment to this country, that we are not helped forward here by such transactions, that every penny of that money is unproductive as far as this country is concerned, that it merely helps other countries against our own, and makes more difficult the progression towards commercial and agricultural development and prosperity which are at present so far from satisfactory attainment.

This point was very definitely dealt with in the Cape House of Assembly in 1904, in the debate on the Additional Taxation Bill, and the "Observer" (Cape Town), on the 25th May that year, in referring to the matter which had been raised by no less a person than Mr. Merriman, pointed out that there were then two purely South African life offices which offered advantages to the South African public not excelled by any British or American office. And these two offices undoubtedly can, in lowness of rates, and of expense ratio, in wise selection of risks, large bonuses, excellence of management, liberal and accommodating contracts of varied kinds, and prompt settlement of claims, hold their own with any other office operating here, whether European or American in origin.

The funds of the South African offices referred to may not be so immense as those of some of the foreign offices, but what does that matter? Everything in successful life assurance is a matter of proportion, and an office with a hundred million of funds may be far less stable and secure and far less worthy of the practical confidence of the public than an office with only a hundred thousand of funds. It is a popular error—but a serious error nevertheless—to suppose that the size of a life office is the measure of its strength. Such important matters as accuracy of valuation, liabilities, expenses, etc., are naturally absent from the unexpert popular mind, but are of as much importance as actual funds and their investment. To judge of an office correctly, it must be judged in all departments of its operations, and taken as a whole—in one point, in several points, indeed, it may be excellent; in others it may be wanting, and these defects may be such as to overshadow and nullify the points of excellence, and may appear in offices originating oversea and operating here, just as much as in offices of local birth.

There is nothing, and can be nothing, inherently bad in South African-born offices qua South African-born offices, nor in Australian offices qua Australian offices, nor in British or American offices as such. What there may be unattractive in any of them is due to faulty and unwise management, and can hardly be due to anything else, in the first instance at any rate.

There are at least two South African-born offices, the South African Mutual and the "Southern"—both purely mutual offices with head offices in Cape Town—whose position, methods of business, stability, and prospects will bear the closest scrutiny. These two offices have

A PROMINENT RAND ENGINEER.



Prof. JOHN ORR,
Professor of Engineering, South African School of Mines.

attained, and justly attained, to the position of national institutions in South Africa, all their operations being confined to the sub-continent, and all their funds invested here. Their rates are very favourable as compared with oversea offices; their funds are ample to meet all their liabilities, as frequently recurring actuarial examinations made by experts of unquestioned ability show, and are safely invested at an average rate of interest which is the envy of offices from oversea; their expense ratios are low; their distribution of surplus funds in the way of bonuses is excellent; the surrender values, "paid-up" policy values, loan values are liberal; their claim settlements prompt and free from cantankerousness; and their management characterised by that happy combination of conservatism and progressiveism which is exactly what is wanted to insure the permanent success of a life office.

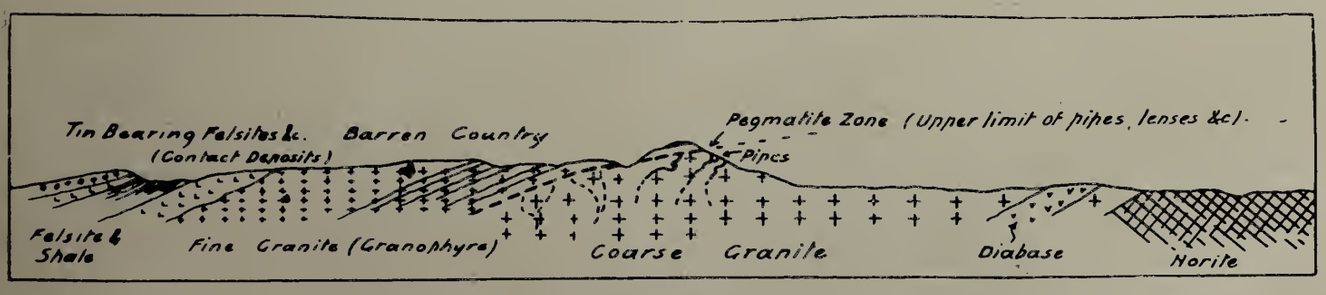
There are two other South African-born offices, the "African Life" (proprietary, head office, Johannesburg) and the "Federal" (proprietary, head office, Cape Town), the former of which already does a large annual new life business, but of these no detailed mention need be made, as they are comparative fledglings, and have yet to win the reputation enjoyed by the two older offices; but their career is being watched with much sympathetic interest, and an equally prosperous and rosy future desired and expected for them. The last-named office, within five years of its establishment, paid a bonus of twenty shillings per cent.

South Africa, as a new and undeveloped country, can only be fostered by the fostering of her own institutions, and these can only be fostered by the practical support of those who are in need of the commodities which they offer for sale. The "on-the-spot" character of the life offices mentioned should and must prove a predisposing factor in their favour, and the South African insurer of to-day, who certainly possesses average intelligence, wanting the best value for his money, will see by a careful comparison of the advantages offered by all the offices that the South African-born ones are as good as any, and better than some, and will adopt that spirit of practical patriotism recently advocated by the South African Premier, who said: "We have a glorious past and we have also an united country. We need now only one thing, and that is the co-operation of all the people towards the one end of building up a powerful South African nationality." One of the first and best and most effective ways in which to do this is to support South African institutions, and, as far as life offices are concerned, we believe that these may be supported without hesitation on their merits, quite apart from any claims of patriotism or country.

It should be the aim of all those who are living in this country, and who are therefore vitally interested in its progress and prosperity, to keep money circulating in South Africa, and not to send it careering round the world. As a young country, we cannot afford to send away what is absolutely necessary to assist growth and development. The outcry is loud against legislation which is likely to have the effect of driving capital out of the country or of discouraging its entrance, and yet the people of South Africa, who suffer periodically from severe depression, send out of the country the very capital which they need, and which, if kept here, could be used in carrying out useful works, and thus assist in making the country richer and its people more prosperous. And how do they do it? Simply by buying insurance (and a hundred other things) oversea which can be bought just as satisfactorily here. This is the "capital" remedy for hard times, and as such we commend it to our readers.

If we are to have in this country a solid national life, then we must have solid financial and business institutions of our own. The successful working of such institutions will prove to the world that the country itself is solid, and that confidence in it, and in its ventures, can be wisely reposed. But our first need in all this, as the Premier has well said, is "Capital, and secondly capital, and yet again capital." Without it we obviously cannot have financial institutions, much less can we have them on a large scale. And it is because life assurance has been independently established in this country by the offices mentioned, and has signally succeeded without the fostering favours of Protection, and not only without Government aid, but also in spite of hindrances and burdens imposed by Governments which should have known and done better, that we are convinced that under the more favourable conditions which we hope may one day obtain, and with a better-educated public mind, the life assurance offices of this country will not only maintain their present just reputation for stability and reliability, but will grow also in bulk, until, with the necessary growth of a white and productive population, they shall, to the superficial eye also, rival the giant champions of the outside world.

GEOLOGY OF THE TIN FIELDS.



Diagrammatic section across Zaaiplaats Tin Mine, showing geological relationships.

Witwatersrand Gold Production

1887 : World's Production, £21,735,000 ; Witwatersrand, £81,045. 1911 : World's Production, £97,233,000 ; Witwatersrand, £33,543,479. The Astonishing Rise of the Rand from Nil to More than a Third in Twenty-five Years

In another part of this issue is given, in connection with the Transvaal gold dividends, a statement of the whole of the gold production of this Province from the earliest recorded years. The following tables show the yearly yield of the Witwatersrand from 1887 to 1911 inclusive :—

Year	Tons Milled	Fine Gold Ozs.	Value £
1887	—	19,080	81,045
1888	—	171,789	729,715
1889	—	306,167	1,300,514
1890	—	408,569	1,735,491
1891	—	601,810	2,556,328
1892	—	1,011,743	4,297,610
1893	2,215,413	1,221,171	5,187,206
1894	2,830,885	1,639,252	6,963,100
1895	3,456,575	1,845,875	7,840,779
1896	4,011,697	1,851,422	7,864,341
1897	5,325,355	2,491,593	10,583,616
1898	7,331,446	3,564,581	15,141,376
1899	6,639,355	3,317,857	14,093,363
1900†	See below.		
1901	412,006	238,877	1,014,687
1902	3,416,813	1,690,096	7,179,074
1903	6,105,016	2,859,482	12,146,307
1904	8,058,295	3,653,794	15,520,329
1905	11,160,422	4,706,433	19,991,658
1906	13,571,554	5,559,534	23,615,400
1907	15,523,229	6,220,227	26,421,837
1908	18,196,589	6,782,538	28,810,393
1909	20,543,759	7,039,136	29,900,359
1910	21,432,541	7,228,311	30,703,912
1911	23,888,258	7,896,802	33,543,479
Totals ...	—	72,326,139	307,221,919
Add	—	34,607	*147,000
	—	584,841	†2,484,247
	—	4,447	‡18,890
Grand totals...	—	72,950,034	309,872,056

*Estimated unrecorded output for years 1887, 1888, and 1889.
†Undeclared output for period October, 1899, to May, 1900 (inclusive).
‡Amount won in 1904, but undeclared.

By way of comparison, the following table, based mainly upon figures in the report of the Directors of the United States Mint, will be of interest. It represents the estimated value of the gold production of the world since 1887 :—

Year	Value	Year	Value
1887 ...	£21,735,000	1899 ...	£63,027,000
1888 ...	22,644,000	1900 ...	52,312,000
1889 ...	25,375,000	1901 ...	53,630,000
1890 ...	24,421,000	1902 ...	60,975,000
1891 ...	26,846,000	1903 ...	67,337,000
1892 ...	30,134,000	1904 ...	71,380,000
1893 ...	32,363,000	1905 ...	78,143,000
1894 ...	37,229,000	1906 ...	82,707,000
1895 ...	40,843,000	1907 ...	84,769,000
1896 ...	41,559,000	1908 ...	90,810,000
1897 ...	48,509,000	1909 ...	93,695,000
1898 ...	58,949,000	1910 ...	96,446,000
		1911 ...	97,233,000

The relative percentages of output during 1911 have been estimated as shown below :—

Country	Value	Percentage of Total.
Transvaal	£34,991,620	36.0
United States ...	19,774,000	20.3
Australasia	12,549,000	12.9
Russia	8,343,000	8.6
Mexico	4,007,000	4.1
Rhodesia	2,681,000	2.8
Canada	2,188,000	2.3
India	2,159,000	2.2
West Africa	1,083,000	1.1
Other countries ...	9,457,000	9.7
	£97,232,620	100.0

TRANSVAAL TIN MINING IN PICTURE



The Mill, Zaaiplaats Tin Mine

A New Type of Induction Motor

Advantages of the "Cascade" Single and Multi-speed Motor described

By M. I. WILLIAMS-ELLIS, A.M.Mech.E., A.M.I.E.E.

VARIOUS papers have been read before engineering institutions with reference to the "Cascade" induction motor within the last few years, so that the writer feels somewhat guilty in introducing a paper, the subject of which may be common knowledge to many.

The subject of this paper will be dealt with in two sections, first of all a short description of the early work carried out upon "Cascade" construction by Professor Silvanus Thompson, Steinmetz, and Gorges and Lydal and others; secondly, a description of the "Cascade" induction motor, both of the single and multi-speed type, and its adaption to mine and general work, patented by L. J. Hunt and maufactured by the Sandycroft Foundry Company, England. Also references to other multi-speed types of motors.

Ever since the discovery of the principle of the three-phase motor by Ferrari in Europe, and by Tesla in the States, it has been the object of inventors to develop a motor which, whilst possessing all the features of the slip-ring machine, would as nearly as possible approach the simplicity and robustness of the well-known squirrel-cage motor.

The "Cascade" system is well-known, especially in connection with polyphase railway motors. The Lacour motor converter, in which an induction motor and a continuous-current generator are connected in cascade, is another example of its use. The principle as applied to induction motors was first discovered by Steinmetz in the States, and by Gorges in Germany. According to their system, two or more motors are used in order to obtain a combination which can be run at two or more efficient speeds. The system as applied to two induction motors of the ordinary design may be briefly described as follows: The motors are mechanically coupled either directly or through gearing, and when running at the higher speed are connected in parallel or separately to the supply circuit. When the speed is to be reduced, the rotor slip-rings of motor No. 1 are connected to the stator windings of motor No. 2, and the torque of the two motors is controlled by connecting resistances to the slip-ring of motor No. 2. If the armatures of two similar direct-current motors be connected in series, the machines will run at half their normal speed. It is the same with induction motors connected in "Cascade"; the speed, if both machines have the same number of poles, will be reduced to one-half—in other words, the effect is the same as doubling the number of poles. Again, returning to our direct-current analogy, supposing one of the motors be wound to run at 750 R.P.M. and the second at 1,500 R.P.M. when singly connected across the mains, then if their armatures are connected in series, the two motors will run at a speed of 500 R.P.M., their fields having normal excitations in each case. The reason for this is that at this speed motor No. 1 will develop 500/750, or two-thirds of its normal back E.M.F., and will thus absorb two-thirds of the line pressure leaving one-third of the voltage for motor No. 2, which will generate the necessary back E.M.F. when running at one-third of its normal speed, equal to one-third of 1,500, or 500 R.P.M.

It is the same with two induction motors connected in "Cascade"; if one be wound for 750 R.P.M. on a 50 period circuit (eight pole) and the other for 1,500 R.P.M. (four pole), then in "Cascade" their speed will be 500 R.P.M. This speed is that of a 12-pole motor, and it follows that for any two motors coupled in this way if one have "X" and the other "Y" number of poles, the "Cascade" speed will correspond to that of a single motor having "X" + "Y" poles.

Instead of electrically connecting the rotor and stator windings of motors No. 1 and 2, the same effect may be obtained by coupling the two rotor windings and connecting the starting or regulating resistances to the stator windings of the second motor; but, as this system has many disadvantages, it has been suggested to use a synchronous motor for the second motor built up on the same shaft in order to bring up the power factor. Another suggestion for getting over the difficulty of high temperature rise is an arrangement whereby one motor is for half time the main, and for the remaining time the auxiliary motor. However, with the above system of operation the cumulative difficulties due to poor power factor, low efficiency, low break-down factor, and increased heating often lead to disappointing results, with the result that up to the present time motors operated in "Cascade" have met with little favour except in special cases.

In Italy extensive use has been made of the "Cascade" system on the railways, two motors being used; the locomotives on the Valtellina line and for the Simplon Tunnel are controlled in this way; quite a number of rolling mills in Sweden have been similarly equipped. The Ganz Company having been the most zealous advocates of the "Cascade" system in Europe, have supplied certain sections of the Italian State Railways with locomotives fitted with two motors, which are located on separate axles, the power being communicated to the driving axles by a connecting rod. One of the motors is wound for 8 and the other for 12 poles, the periodicity of the supply being 15 cylces per second, and with these two numbers of poles, three speeds—namely, 225, 150, and 90 R.P.M.—may be obtained. In the case of the earlier locomotives supplied to the Valtellina line, the two rotors and stator were supported in one common housing.



Malgo Copper Mine

It is well known that either the stator or the rotor of an induction motor may be wound for connecting to the mains. It is usual to make the stator the primary member, as, generally, the supply voltage is higher than that induced in the secondary part of the machine. It is therefore obvious that in coupling two motors in "Cascade," the same effects can be obtained by connecting in series the two rotors as by connecting the rotor of machine No. 1 to the stator of motor No. 2. By doing this the starting resistances are connected to the stator instead of to the rotor slip-rings, so that if the two machines are required to always operate in "Cascade," slip-rings are no longer necessary. This is the second step in the development of the "Cascade" motor.

The next steps in the development of the machine were made by Dr. Silvanus Thompson and Mr. Lydall in 1901 and 1902. Instead of using two separate motors, a single machine was used carrying two magnetic fluxes. In Dr. Thompson's motor, alternate sections of the stator carry primary and secondary windings, and the motor carries windings which receive energy from the stator by induction and produce the second flux, which in its turn acts on the secondary windings of the stator. In Mr. Lydall's motor, both stator and rotor carry two independent windings, the rotor being provided with six slip-rings; but, as already stated, the chief objections to a motor consisting of two stators and two rotors or one common rotor are, the high cost, low efficiency owing to greatly increased copper losses, low power factor, and small overload capacity. Patent records show that considerable attention has been given to the problem of producing a "Cascade" motor which shall be free from the objections given above. In the case of the single housed machine, a great deal depends on the spacing of the stator coils to render the primary and secondary elements inductively independent of one another; but, in the case of Mr. Lydall's, it is entirely dependent on the choice of two numbers of poles on the two fields. As long as the number of poles are so chosen that they are mutually non-inductive, the two sets of windings and their fluxes are independent of one another, and the single motor acts as if the windings were carried by two separate machines. In all these machines the presence of separate sets of windings require considerable space for the accommodation of the conductors, and it would appear that the magnetic leakage must be considerable; further, the use of these independent windings militates against the production of an efficient motor. Patents have been taken out by Steinmetz and Mellin on much the same lines as Dr. Thompson's, the latter using a disc type of rotor in order to make it possible to use very small clearances.

As the possibility of efficient variable speed working is of extreme interest to all engineers alike, it may be here well to mention that the "Cascade" system of operation offers at present the most feasible solution of the problem from the writer's point of view, when dealing with polyphase machines. It may, however, be argued that for small machines a mechanical device for changing speeds would be more suitable, but for machines of large size there would be great objections, and I do not think that mining engineers would much care for their use. The whole idea is to get a reduction and not an increase in the amount of gearing, especially when motors can be built with high efficiency and power factor at low speeds. The present tendency to couple motors direct to winding engines, pumps, etc., without the use of any gearing is evidence of the growth of this feeling. The writer much regrets that he has not had time to get out curves for mechanically controlled speed variations and electrically controlled speed variations, as these would be interesting to many.

As has already been pointed out, Messrs. Ganz have had the "Cascade" system in operation for many years for railway work with the object of speed variation. The following is a brief description of the locomotive supplied by Messrs. Ganz for the Valtellina Railway, in which the two motors operated in "Cascade" were constructed as a single machine. Each locomotive carried two such combination sets. The supply was 15 cycles and 3,000 volts, and the secondary for 400 volts. Each motor was wound up for 8 poles, and so had a synchronous speed of 225 R.P.M. and a "Cascade" speed of 112.5 R.P.M. For the higher speed the low pressure mains were cut out of circuit, the load being carried entirely by the two 3,000 volt motors. When only the primary motors were in circuit, slip-rings are employed, which lead to external resistances and are employed at starting. When the motors are "Cascade" connected, the current is carried directly from the windings of the rotor of the primary motor to the windings of the rotor of the secondary motor. Consequently for "Cascade" connection slip-rings are not required. The primary motor, if it had been constructed as a separate machine, would have weighed 8.2 tons. This is increased to 12.4 tons by the additional weight of the secondary motor. A further description of this may be found in Hobart on Electric Motors. Messrs. Brown Bouveri and the Oerlikon Company have developed three-phase variable speed squirrel-cage motors for railway work, the windings being so arranged as to supply 16, 12, 8, and 6 poles; the employment of a larger number of poles at starting than are employed during normal running is in the interests of improved starting torque. The stator windings in the last type of machine are so arranged that, at starting, and half-speed running, they constitute a 12-pole mesh connected winding, while for full-speed running a 6-pole parallel connected "Y" connection is obtained.

Leaving the question of two-speed and returning to the construction and design of the "Cascade" motor proper, one finds the improvements introduced by Mr. Hunt consist of the blending together of the independent stator windings and the discovery of an entirely new series of windings characterised by the simultaneous production in a single winding of two separate magnetic fields. In the stator an ordinary winding is used, and is divided into sections connected in parallel. In one of the parallel connected sections the supply currents and the currents induced by the action of the rotor flow in the same direction, whilst in the second section the direction of the flow is opposed. If a resistance be connected across these sections, no primary currents will flow because there will be no difference of potential, but the resistance will form a path for the induced currents as these are reversed relatively to the primary currents. These resistances are used for starting or speed regulation. The complete stator windings are built up of these sections, each phase being so arranged that all the primary currents from one terminal to the neutral flow in the same direction, whereas the flow of the induced currents in alternate sections is reversed. Fig. (1) represents diagrammatically a stator winding, the direction of the currents being indicated by full line arrow heads for the primary currents, and the small arrow heads for the induced or secondary currents. The main terminals are marked "T" and the tappings "A." The starting resistances are connected across four pairs of tappings, and the remaining two pairs are short-circuited in the starting tappings, when the machine has reached full speed. The number of poles must be so chosen that when divided by their greatest common factor the quotient is in one case an even and in the other an odd number. This ensures non-interlinking of the two windings; except by the agency of the rotor,

the first set of poles that satisfies this condition will be of the numbers 8 and 4, so that the highest synchronous speed on a 50-cycle will be 500 R.P.M., the 8 and 4 poles making up the 12-pole stator circuit. It will also

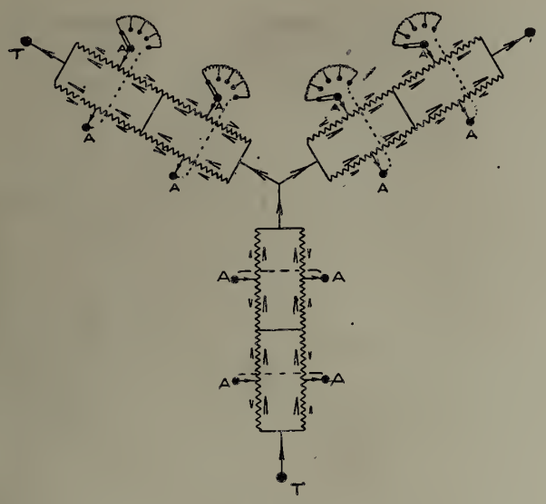


Fig. 1.

be noticed that any other number of poles less than 8 and 4 will give an unbalanced field. In Mr. Hunt's paper (read March 19th, 1907, Inst. E.E.) he states that the chief difficulties to be overcome in the design of a "Cascade" motor are greatly increased magnetic leakage and C^2R losses. Where two stator windings are used, the inductance of the one occupying that portion of the slots farthest removed from the rotor is very large, owing to the increased leakage from tooth to tooth. He gives the results of an experiment he carried out upon a motor wound with two separate windings of 8 and 4 pole, the former being placed nearest the rotor, and found that the leakage per ampere-turn per inch length of core (after deducting the leakage of the end connections) was 7.0 in the case of the 8-pole winding. By doing away with the two windings and using only one, the difficulty was overcome, the same motor showing that with the one winding the power factor and efficiency was much increased. The maximum induced voltage across any one pair of tappings is about one-third that of the line voltage, and the starting resistances are designed to suit this. By varying the resistances, the starting torque and speed are controlled, the current for a given torque being the same whether the machine is standing or running. The rotor windings are also of the barrel type, and are in appearance similar to those used with motors of ordinary design, except that one-fourth of the bars are omitted.

It may here be interesting to some to show two diagrams of a 4-pole and 2-pole winding and the resultant third diagram produced by Fig. 2a and Fig. 2b,

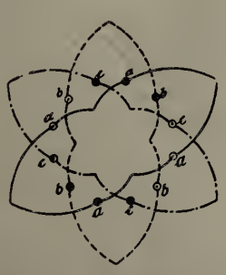


Fig. 2a.

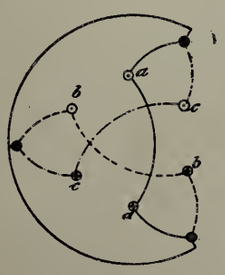


Fig. 2b.

although 4 and 2 poles have been chosen it may be mentioned that, as the resultant magnetic field is not symmetrical, a motor having this number of poles is not satisfactory, and this number of poles have only been chosen in this instance for simplification of the diagrams.

The currents of the two rotor windings in any one slot may be algebraically added together and considered as one current. By suitable arrangement of the connections one winding may be substituted for the two, and the total C^2R losses reduced to that of the "X" pole winding only. Fig. 2a and Fig. 2b show the directions of the currents in the 4-pole and 2-pole windings at the instant when the current in the "a" phase is equal to m, and those in "b" and "c" phases to $\frac{m}{2}$. Two pole bars occupy only one-half the slots. By super-imposing one diagram upon the other it is found that some of the currents cancel one another, and we get the resultant diagram shown in Fig. 3.



Fig. 3.

Let us consider the case of a rotor for a 12-pole motor having 8-pole and 4-pole magnetic fields. The rotor is acted upon by the 8-pole magnetic field produced in the stator by the supply currents. The rotor current thus induced is required to generate in addition a 4-pole field, which in its turn will act indirectly on the stator. Set out on paper a series of crosses and dots to represent the directions of flow of the 8-pole rotor currents, and underneath these set out in the same way the currents to produce a 4-pole field. By shifting the relative position of the two windings a position will be found where at six equally spaced parts of the windings currents in the two windings neutralise one another. This having been done, the remaining bars are connected up to form a combined star and mesh winding, which is closed upon itself, and it follows that this winding will produce exactly the same effects as the two independent windings of 8 and 4 pole. Instead of having two separate windings, one of 4-pole and the othe rof 8-pole pitch, we have a single winding of 8-pole pitch with two bars per slot in three-fourths of the slots, and one bar in each of the remaining slots. A photograph of a 300 B.H.P. "Cascade" rotor is shown in Fig. 4. Owing

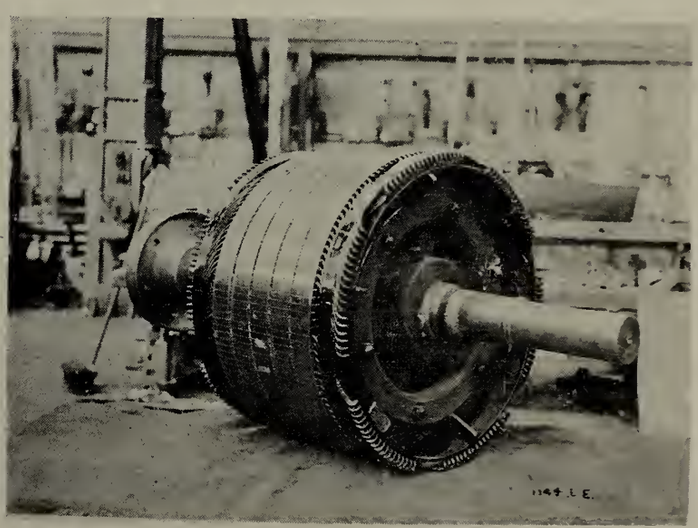


Fig. 4.

to the presence of two magnetic fields in the one machine a very even turning movement is obtained at creeping speeds, and consequently these motors can be run at

dead slow speeds on resistance. When the 8-pole conductors are in the position of maximum torque the 4-pole conductors are entering their minimum effect, and it is for this reason that the eveness of turning found in system of "cascade" working is not found on motors having only one field. The writer has tested one of the machines in question running at the dead slow speed of 3 R.P.M. with full load torque, the speed being practically uniform.

The slip of the motor at full load is depeendent upon the resistance of the windings in which the secondary currents circulate. In the case of the "cascade" motor these windings are situated on the stator and their resistance is low, as they have to carry the supply currents as well as those induced by the rotor. The slip of these motors is consequently very small, being of the order of one-half to one-third of that of motors of ordinary design. The change in speed between no load and full load is very slight, the slip of a 100 B.H.P. motor being about 1.2 per cent.

This construction therefore permits of the use of induction motors with short circuited rotors for driving all classes of machinery where it has before been necessary to use motors of the slip-ring type. All slip-ring troubles being avoided, and as "cascade" rotor windings are connected to parallel groups of conductors,

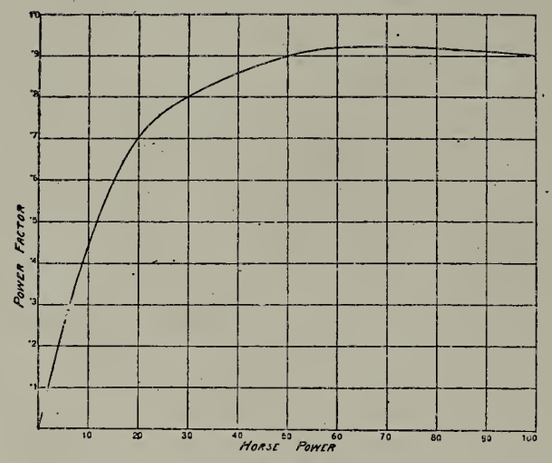


Fig. 5.

the maximum voltage when standing can never exceed a few volts. In small motors it is of the order of 4 to 5 volts, and in machines of over 500 H.P. size it will not exceed twenty to thirty volts. The rotors are consequently practically indestructible, and except from mechanical injury have never been known to break down.

The parallel connection of the stator and rotor coils prevents large differences of flux density in the gap even when the motors are badly out of centre, and the machines are consequently not subjected to large unbalanced radial faces. There is therefore very slight wearing of the bearings, and small air gaps with improved power factors are permissible. These machines the author has installed for all classes of mine work; their unique feature in the way of gradual starting and speed control have given them a position entirely their own.

The absence of slip-rings and the robustness of the rotor construction is also giving them a wide field for the driving of all classes of machinery in dusty situations, and for these reasons alone a large works in America is being entirely equipped with machines of this type. Of this installation, which is a very large one, it may be of interest to mention that there will be twenty "cascade" motors of 180 B.H.P. capacity each for driving tube mills, and a large number of others. Fig. 5 shows a power factor curve of a 70 H.P. single-speed "Cascade" motor installed for the B.L.F. Co., the second machine of this type ever installed for this class of work. Fig. 6 shows a photograph of the actual machine in operation. Fig. 7 shows another "Cascade"

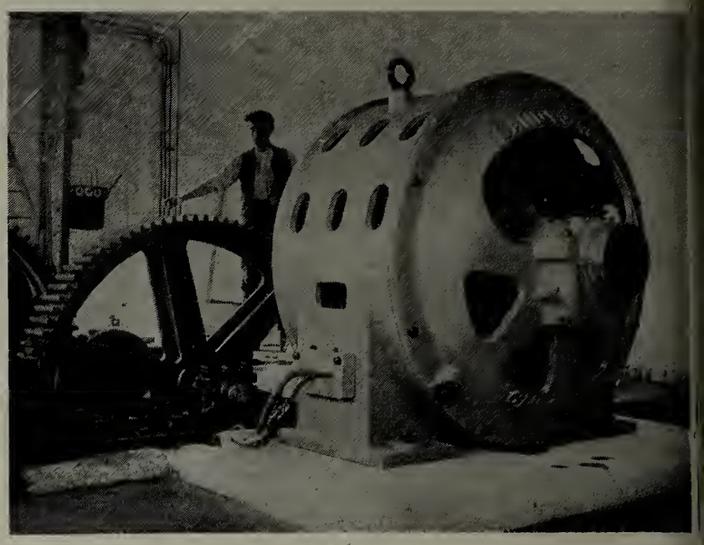


Fig. 6.

haulage motor, and Fig. 8 a 500 B.H.P. "Cascade" motor for driving an air compressor for the Mysore G.M.C.; the full-load efficiency was .93 and power factor .92. Fig. 9 a 50 B.H.P. "Cascade" motor for driving a three-throw mining pump. "Cascade" winders are now in course of erection for the Mysore G.M. Co., while complete plants consisting of the above type of motors have been in operation on many mines in England, America, Spain, Siberia, India, and on the West Coast of Africa for some two years.

MULTI-SPEED MOTORS.—The synchronous and the induction motor are constant speed machines, and are not easily adaptable to variable speed working, since the synchronous motor must run in exact step with its generator, and the induction motor runs at a speed very slightly below synchronism. The first-named motor cannot be varied in speed, and the induction motor can only be varied at the cost of great loss in efficiency. Of course, if the question of efficiency is of no consequence such a method of changing speed may possibly in some cases be more or less satisfactory; this method is well suited to hoists and cranes, as even in direct-current work resistance control is necessary. There



Fig. 7.

is one exception, however, to the above restrictions regarding variable-speed working. Since the motors follow the generator in speed, it is possible to vary the speed of the motor by varying the speed of the

generator; and in the few cases where this is permissible efficient speed variations may be obtained in this way; this, however, the author thinks would be possible only in a very few cases.

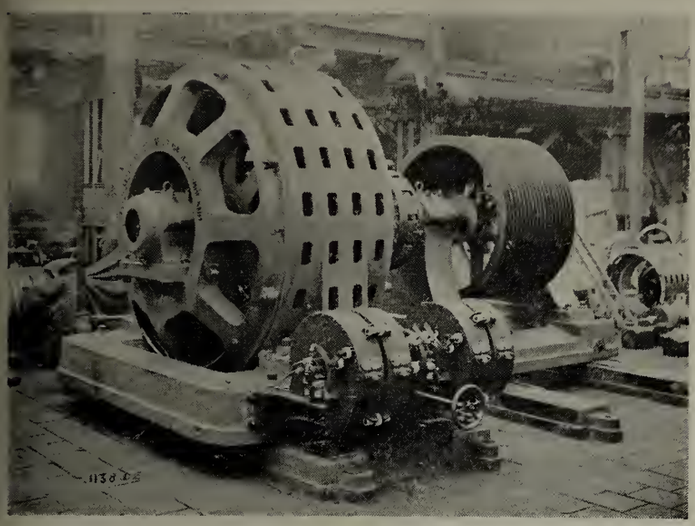


Fig. 8.

Of course, there is again the change-pole type, which has been used to some extent; this method does not seem to have made many advocates owing to the poor electrical qualities of many designs, while one has the disadvantage of having to break the main circuit in order to change the number of poles, and which is not found in the "Cascade" variable-speed machine of the two-speed type, so that the whole operation can be brought about without sparking.

Fig. 10 shows diagrammatically the stator and rotor windings of a two-speed "Cascade" motor, Hunt's patent.

If the motor be wound for 8 or 4 poles, then at 50 cycles per second the two efficient speeds will be 500 and 750 R.P.M. The 4-pole winding on the rotor is here shown △ connected, and the 8-pole winding Y connected.

In the rotor winding already described of the "Cascade" motor, it has been pointed out that by omitting one-fourth of the bars of a barrel winding, the remaining bars produce two magnetic fields. The winding is really an 8-pole winding, in which certain of the bars have been removed from one part of the periphery and added to parts displaced by 360 electrcial

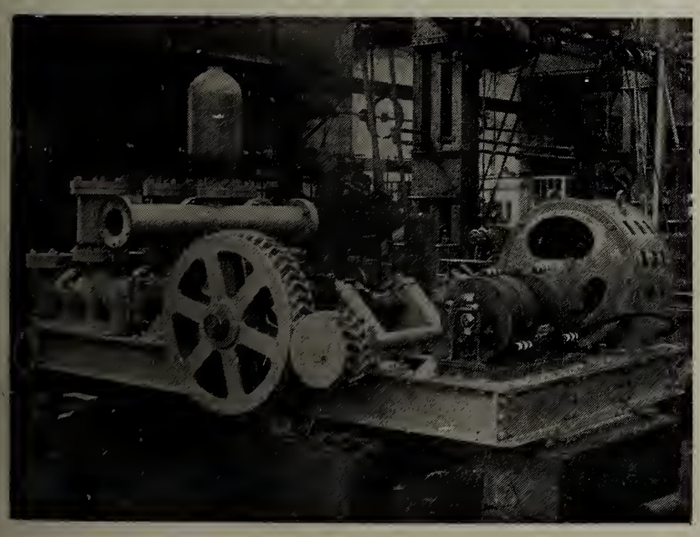


Fig. 9.

degrees. The actual number of ampere bars in the unsegmential or 8 and 4-pole winding is the same as in the simple 8-pole winding. If the slots from which bars are omitted be now fitted with additional bars, the winding at once becomes segmential, *i.e.*, there are the same number of bars in each slot, and therefore, if all the conductors are carrying current, only the 8-pole field is produced.

In the actual rotor these extra windings are connected at one end to the rotor windings and the other to three slip-rings. With the slip-rings short circuited the distribution of the currents in the rotor windings are

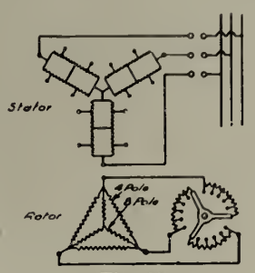


Fig. 10.

uniform, and the "Cascade" effects no longer exist, the machine consequently runs at 8-pole speed, and thus efficient speeds are obtained. The two-speed motor in its most useful form gives the same torque at both speeds, the output being proportional to the speed.

The method most universally adopted for speed regulation is to place a non-inductive resistance in the rotor at starting. The disadvantage of this method is obvious to all, and is comparable to regulating a shunt-wound motor by putting resistance in the armature circuit. The method employed by Messrs. Ganz might be termed the "concatenating" or "cascade" system; this method, besides regulating the speed, ensures a large starting torque, but is only feasible when motors are used in pairs. This method is shown in Fig. 10b and refers to the traction scheme of variable speed working mentioned at the beginning of this paper. The motors connected in this way will start with a large torque, but their maximum theoretical speed cannot exceed one-half of the motors directly connected across the line.

The "Cascade" motor is being used largely for driving machines where two definite speeds are required, *e.g.*, air compressors, rolling mills, ventilating fans, pumps, etc. Where only two speeds are required it is customary to provide a three-phase starter for the rotor only, the motor always being started as a plain slip-ring machine. A short circuiting switch is mounted on the side of the starter, connected with the starter tappings, and when "cascade" speed is required the motor is brought up to this speed by means of the rotor resistance, and after closing the starter short circuiting switch, the rotor starter is brought back to the "off"

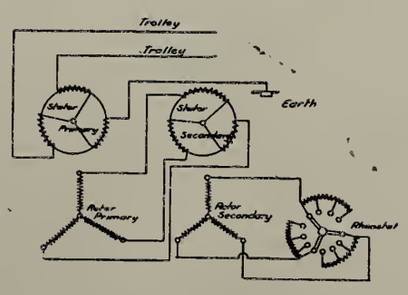


Fig. 10b.

position. When the motor is required to run at full speed the tapping switch is open circuited and the slip-ring resistance cut out, and finally the slip-rings are short circuited. There is yet another class of machine when a large number of speeds are required, say, between full and half speed. In this case resistances are also provided for the stator tappings, and a combination controller is supplied. The efficiency falls with the

speed until two-thirds speed is reached, when the motor runs at "Cascade" speed. The efficiency at once rises, as there is no loss in resistances to a value generally about two per cent. less than that at full load and full speed. The further reduction in speed is brought about

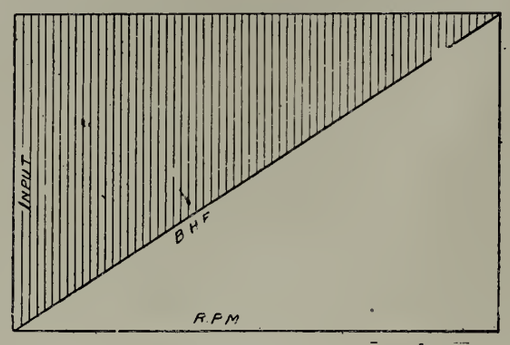


Fig. 11.

by inserting resistances in the stator tappings. With this arrangement a greatly improved average efficiency is obtained.

While dealing with the question of variable-speed motors, it might be interesting to mention the system that is being put into operation for the electrical propulsion of a naval collier for the United States Navy and battleship. It is proposed to instal for the collier one turbo generator running at a maximum speed of 2,000 R.P.M. and delivering current at a potential of 2,300 volts to two induction motors, one on each propellor shaft, with a speed reduction in ratio of 18 to 1. The efficiency of transmission is expected to be about 91 per cent. In the case of a battleship, the proposed form of electric drive contemplates two turbo generators driving two motors on each of the two main shafts. This multiplicity of units, combined with a pole-changing device on two of the motors, promises an economy close to the maximum at all speeds above ten knots. The electrified plant for the above case is to be manufactured by the G.E. Co., of America. Comparing the electric with the mechanical reduction gear, it is at once evident that the latter has the superior efficiency of transmission. In the case, however, of a vessel in

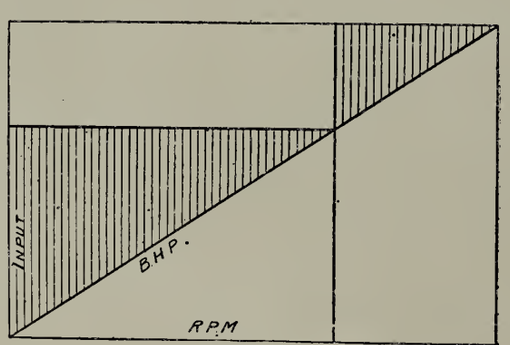


Fig. 12.

which economy at the lowest speeds is required, the flexibility of the electric installation as outlined for a battleship might overcome this advantage.

Returning to the "Cascade" system again, diagrams Fig. 11 and Fig. 12 show clearly the advantages gained by use of a two-speed motor from an acceleration rheostatic loss point of view; Fig. 11 showing the rheostatic loss of the ordinary slip-ring motor during the period of acceleration, while Fig. 12 shows the losses of a two-speed motor also during the period of acceleration, showing a large saving in favour of the two-speed motor of approximately 45 per cent.

In drawing out these diagrams it has been assumed that the motor has no internal losses, as this simplifies the diagram and introduces no material error. In Fig. 11 one-half of the energy supplied from the line is lost in heating the rotor resistances. In Fig. 12 the conditions for the two-speed motor are shown, the cross-hatched portions showing the resistance losses as before. If the input is maintained constant throughout the accelerating period at the same value as that required by the one-speed motor, the time taken to attain full speed will be reduced by 21 per cent. Or, if the time for acceleration be the same as for the one-speed example and the energy input be kept constant, the number of kilowatts required will be reduced by 21 per cent.

To get full load torque, only .7 of full load current is taken, while to get twice full load torque 1.4 times

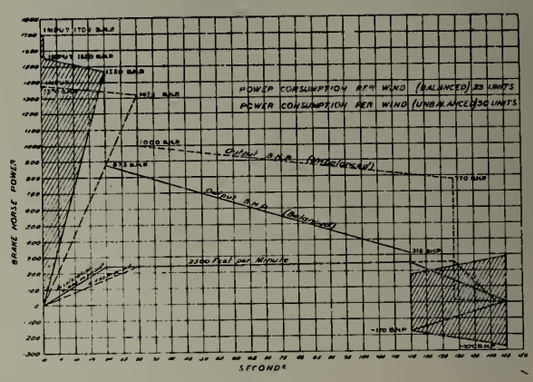


Fig. 13.

full load current is only required; this the author considers a great advantage in the case of winders where often rapid acceleration is required, also for such purposes as traction work. For a given input the motor at "Cascade" speed develops 40 per cent. to 50 per cent. more torque than when running on the slip-rings. The most economical method of operating the winding engine is therefore to start with the maximum amount of energy required during the winding, and to run up to speed with high acceleration up to two-thirds speed. Above this speed the slip-rings are brought into operation, and for the same energy input the acceleration is reduced. With this system of control the efficiency winders should be large.

From this it will be gathered that there is a large saving in maximum demand, a question that has always to be given a great deal of consideration in the laying out of electrical installations. To explain this more fully winding diagrams are shown in Fig. 13 and Fig. 14, the figures being those for an actual winder of the ordinary induction type and two-speed "Cascade" type. From the comparison of these two diagrams and figures one sees that the root mean square output of the two-speed

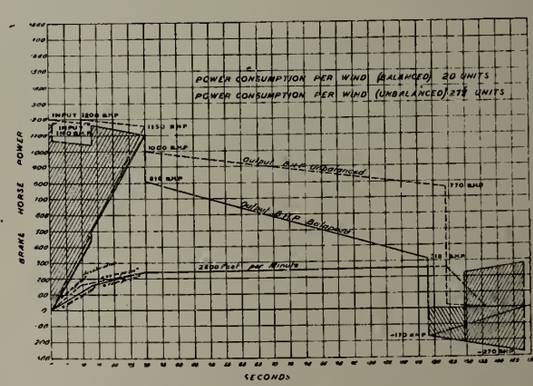


Fig. 14.

"Cascade" motor would be about 650 B.H.P., while the root mean square output of the ordinary induction motor would be 750 B.H.P., showing a saving by the use of the two-speed motor of approximately three units per wind, apart from the saving in maximum demand. The

depth of the shaft was 1,525 m., and an incline of 25° drum speed 85 R.P.M., motor speed 580 R.P.M., masses balanced (5,315 kgm¹sec²), unbalanced (3,935 kgm¹sec²).

A further advantage in the use of the two-speed "Cascade" winder is that while the motor is slowing down from full speed to two-thirds speed the machine is acting as a generator and returning energy to the line and so having a braking effect upon itself. This is, of course, due to the fact that in slowing down from full speed to two-thirds speed the motor is running above synchronous speed. There is again the great advantage of this

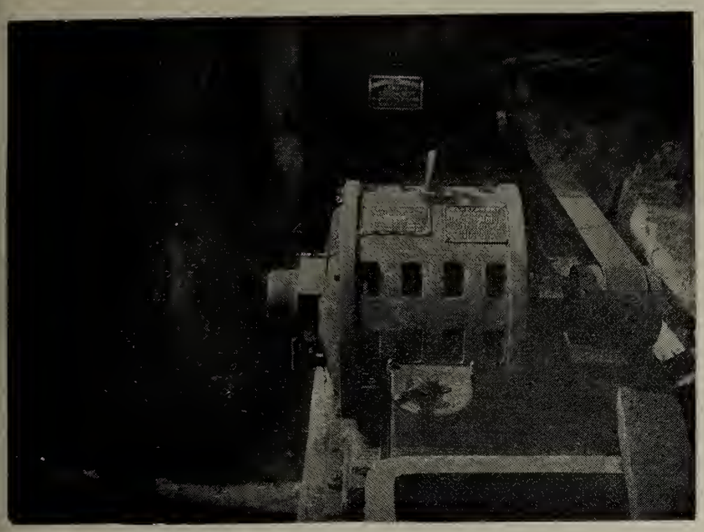


Fig. 15.

regenerative action in the case of lowering unbalanced loads with two-speed motor. As the loads can be lowered at a slower speed than when winding, yet the motor will still regenerate back to the line.

Fig. 15 shows a small two-speed motor of the "Cascade" type in operation that the author installed for forced draught work for water tube boilers, while Fig. 16 shows the actual power factor tests taken from this machine at its two speeds. Fig. 17 and Fig. 18 show the power factor and efficiency curves of a 320 B.H.P. two-speed "Cascade" fan motor for ventilation purposes installed in an Indian mine. Fig. 17 first

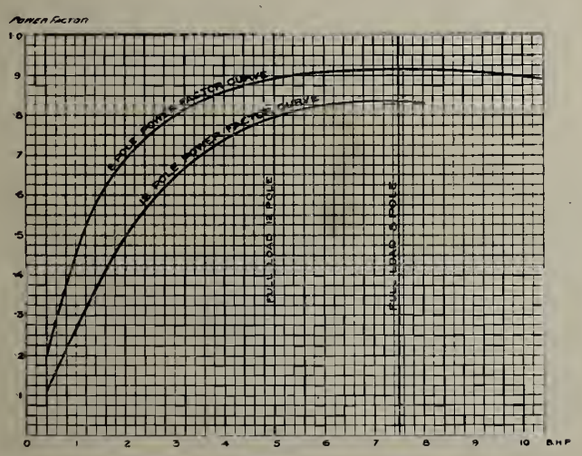


Fig. 16.

speed curve 320 B.H.P., 360 R.P.M., 50 periods, 2,200 volts. Fig 18 second speed 215 B.H.P., 247 R.P.M., 50 periods, 2,200 volts. Now as the power taken to drive a fan varies as the cube of the speed, it follows that in this case the approximate power taken by the fan at the second speed would be 95 B.H.P. and not 215 B.H.P., and one will notice that at this power the efficiency is 90 per cent.; the power factor could still further be improved by reducing the overload capacity and using a new type of stator winding. Fig 19 shows the curve of the same size machine as those that gave the curves in Fig. 17 and Fig. 18, but with the stator winding arranged so that the machine works at best efficiency and power factor when giving only 95 B.H.P. The short circuiting of three terminals of the winding changes the

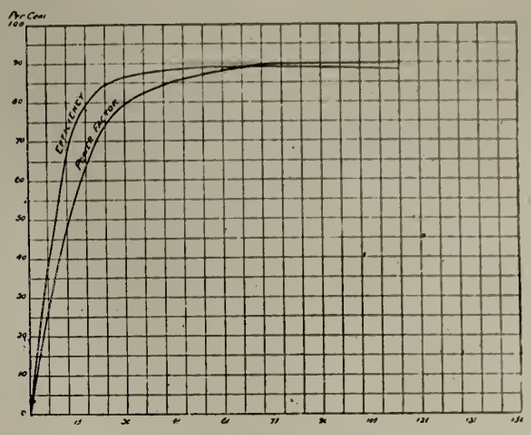


Fig. 17.

effective number of stator conductors and so gives the necessary improvement in the curve, Fig. 19. It may be remarked that the overload capacity of a two-speed motor expressed as "torque" remain practically constant at all speeds. For ventilation purposes of a mine in South Wales (Great Western Colliery) the first large three-speed "Cascade" motor of 400 B.H.P. is

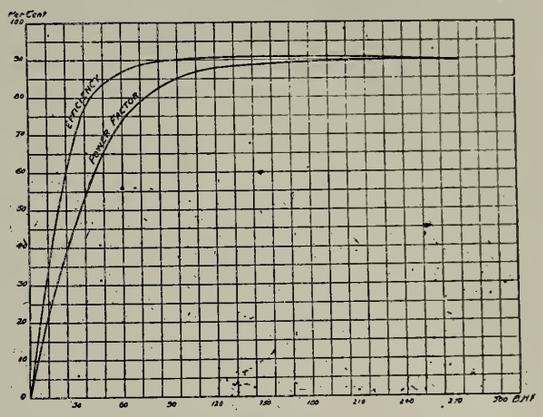


Fig. 18.

being erected, the speeds being as follows: 300, 150, and 100 R.P.M. The modification of the "Cascade" two-speed machine to a three-speed machine is quite a simple matter only necessitating the addition of extra slip-rings and the change-over switch in the stator circuit, which enables the motor to run at three efficient speeds without rheostatic losses.

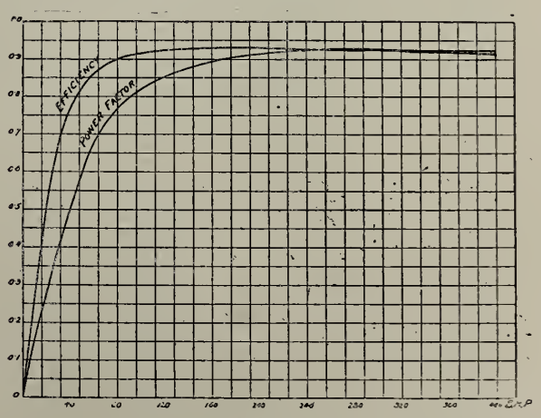


Fig. 19.

Fig. 20 shows the efficiency curves of 12-pole one-speed, and 12-pole and 18-pole two-speed 300 B.H.P. "Cascade" motors, while Fig. 21 shows the power factor and efficiency curves of two-speed "Cascade" motor,

60 B.H.P. at 715 R.P.M., and 40 B.H.P. at 490 R.P.M. Fig. 22 shows a variable-speed pumping plant. Fig. 23 shows a variable-speed "Cascade" motor-driven compressor set, the speed of the motor automatically rising

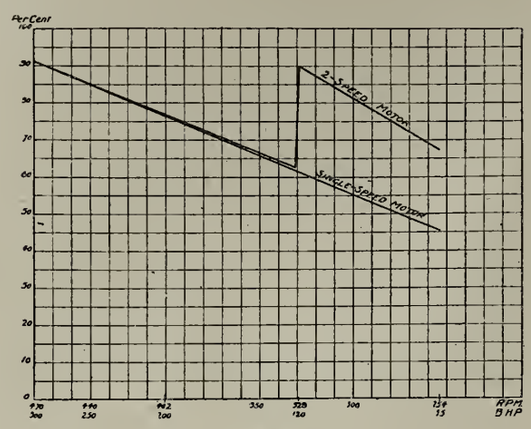


Fig. 20.

and falling, the speed being regulated by the rise and fall in air pressure; such sets giving highly efficient and satisfactory results. The actual method of control is explained at the end of this paper for the above system of speed variation, while actual photographs of the gear itself are reproduced; there are, however, other systems

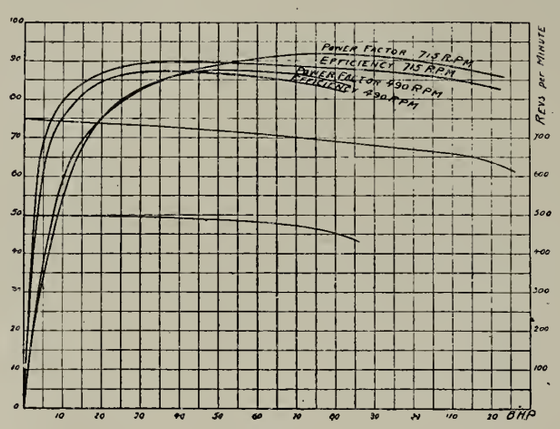


Fig. 21.

for the automatic operation of the controller which are not mentioned in this paper.

The combination power consumption curves of a Bellis and Morcom's Sandycroft compressor set are shown in Fig. 24, and gives one some interesting information as against single-speed control and show a net saving in favour of the variable-speed operated compressor. The compressor is of 5,000 cubic feet

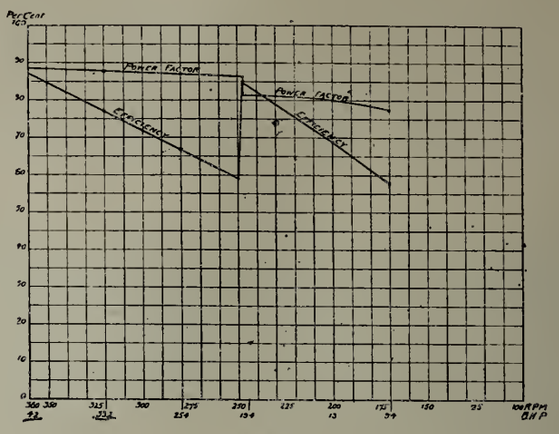


Fig. 21a.

capacity, and when driven at constant speed is governed by entirely shutting a valve in the suction whenever pressure exceeded 81 lbs. per square inch. With the two-speed compressor set the speed is reduced to two-thirds full speed at 81 lbs. and throttle closed at 82 lbs.

For rolling mill work the ideal motive power for rolls

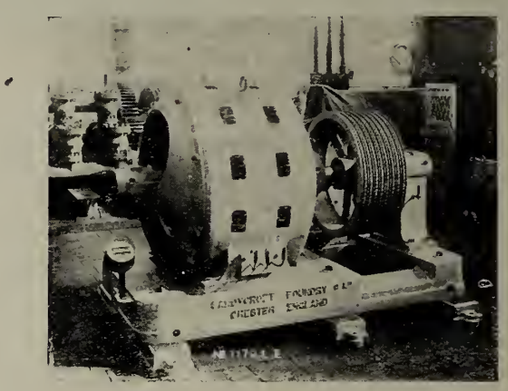


Fig. 22.

should be to drive them slowly when the steel enters and to drive them faster as the piece lengthens. The reciprocating engine will do just the reverse, namely, run very fast without load and slow down as the load increases, finally stopping if the load becomes too great.

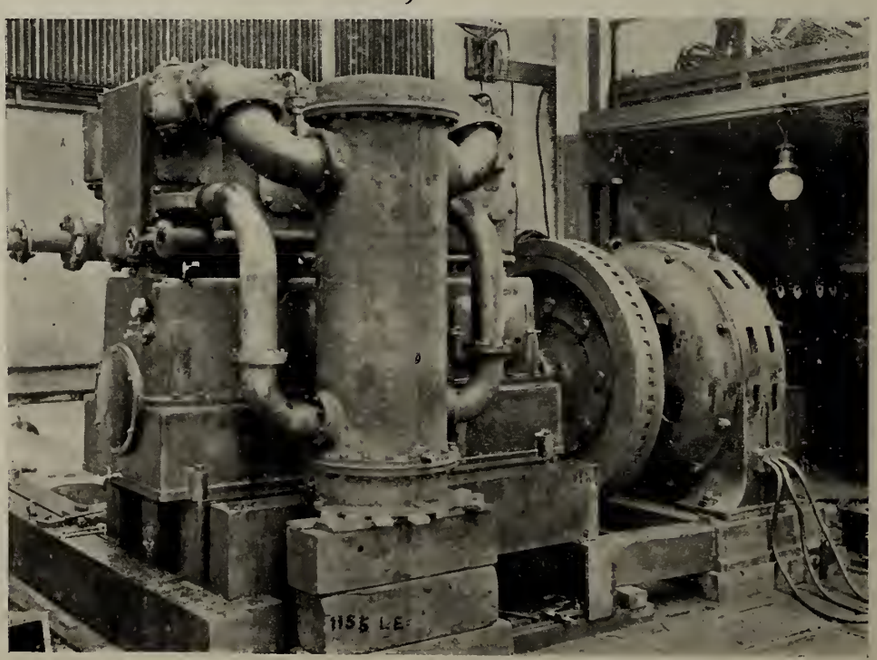


Fig. 23.

This is the chief reason for so many complete electrifications of rolling mills. With "Cascade" motors directly connected to the rolls results should be good, owing to the even starting movement due to the overlapping of

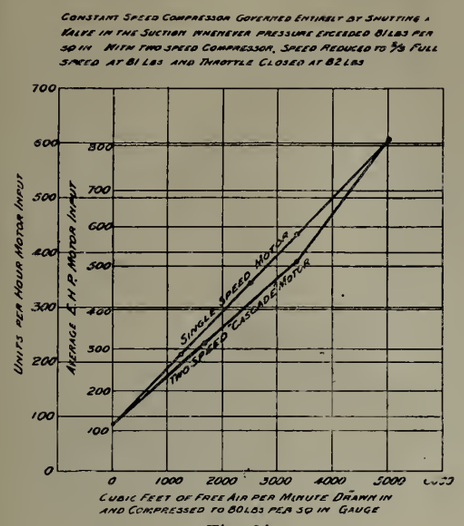


Fig. 24.

the two fields in the stator. The two-speed or even three-speed "Cascade" motor has great advantages for such work, as in the first place it offers the ideal conditions for the operation of the plant for the production of steel, and secondly it keeps the peak load down to a more normal level than that found with the ordinary induction motor, at the same time having high starting torque and a great saving in rheostatic losses, where in the case of the ordinary induction motor the introduction of variable resistances, changing the number of poles, shifting phases, etc., have all their objections in both the way of efficiency and higher running costs.

Having given a description of the "Cascade" motor and its adaptation to various classes of work, it here might be interesting to give a rough description of the type of controller used in the case of a variable-speed motor-driven compressor set. Fig. 25 shows the general design of such a type of controller mentioned; of the Wolliscroft patent type. The actual description of the apparatus being as follows: The drum containing the electrolyte is circular and contains the dippers in the top half, the electrolyte being in the lower. To start up the motor the drum is rotated through 135°, which is worked automatically by means of a cylinder and piston, operating through a rack on to a pinion on the drum spindle. The direction of the movement of the piston is

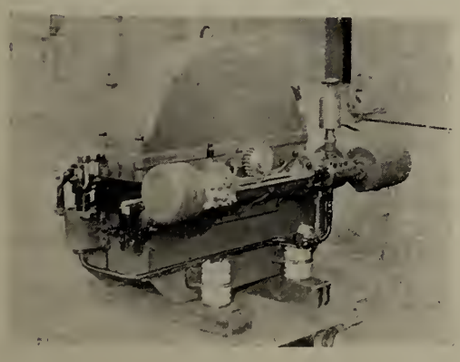


Fig. 25.

controlled by an electrically-operated valve, the solenoid operating this valve being in circuit the whole of the time that the motor is running at top speed. The valve is moved by the solenoid against the action of a spiral spring in compression. The complete operation is as follows: The controller is first started up by hand, allowing the motor to attain full speed, the motor running at this speed until the pressure in the receiver reaches a predetermined value at which the air compressor inlet shut off will operate. Connected to the latter is a small single-pole switch, which will open the circuit of the solenoid operating the valve of the controller mechanism, the spring will then move the valve over and allow the liquid controller to move to the "off" position, thus bringing the speed of the motor down to two-thirds full speed. The motor will then run at this speed until the air pressure drops and allows the shut-off valve to open; by so doing the S.P. switch will be closed and the solenoid again energised, thereby moving the valve over and allowing the controller to be moved into the "full on" position. The motor, of course, runs at two-thirds full speed through the closing of the stator tappings with a switch automatically operated by the slip-ring controller; at this speed the motor is running on "Cascade" connections. The "Cascade" switch or tapping switch is opened by the controller when the motor is required to run at top speed. This switch would be held open by hand when starting the motor from rest. A large number of "Cascade" motors are now being adopted for such work as textile machinery, also printing presses, etc. Fig. 26 shows the control arrangement adapted to printing presses for "Cascade" motors.

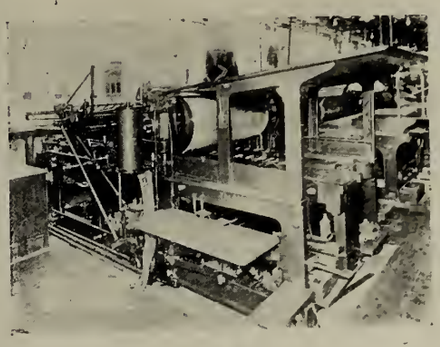


Fig. 26.

In conclusion, the author much regrets having had to leave out certain data in the actual paper, but which, when replying to the discussion and criticism, he hopes to present.

RAND MINING IN PICTURE



Excavator

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The Progress of Banking in South Africa

NOWADAYS the progress of banking in any particular country is a very good index to the economic progress of that country. The welfare of a bank is bound up in the district, country or countries, in which it carries on business; while, on the other hand, the welfare of a country depends largely upon the extent to which its banking system has developed and the stability and management of its banks. If in any country there is little demand for banking facilities, that fact is a sure sign that the country in which such a state of affairs exists is in a backward industrial condition.

An examination of the commercial development of the various countries of the world at the present day will show that the foremost nations are those in which banking facilities are most easily obtainable. By means of banking, the various small sums which would have remained unproductive in the coffers of their owners are collected into large amounts in the hands of bankers and lent out by them to those who are able to employ capital to advantage. Thus bankers make the capital of a country as productive as possible, and by increasing the amount of loanable capital stimulate trade and industry throughout the country. Apart from this, the use of cheques is a considerable advantage to the community, as it saves much time and labour in the collection and payment of debts, and a banking system affords facilities for the transfer of money from one place to another at a minimum of cost and trouble.

Gilbart also lays stress upon the influence which banks exercise on the morals of society, for they encourage the industrious, prudent, punctual, and honest, whereas they discountenance the spendthrift and the gambler.

Banking in South Africa at the present day has reached a very high standard, but the early history of the South African banks does not afford pleasant reading, for the failures were many, and due in most cases to mismanagement and imprudent advances. At the present time, however, the position of the South African banks is very strong, and the fact that the years of depression following the war saw no failure, or even threat of failure, is eloquent testimony to the careful management and sound banking principles adopted by the controllers of our financial institutions.

The first bank established in South Africa was the Lombard or Loan Bank, which came into existence in 1793. Its capital was 80,000 rix dollars, and it was founded "with a view to checking those usurious transactions which naturally accompany a currency insufficient for the commercial and home transactions of any society." The bank was authorised to issue notes, but apparently abused the privilege, with the inevitable result that the notes, in course of time, depreciated in value, and by 1822 were worth only one shilling and sixpence each, as compared with their face value of four shillings. By an Ordinance of 1825, the legal value of the notes was fixed at one shilling and sixpence, and in 1830 the issue was called in by proclamation. The bank was finally wound up on December 31st, 1842, and thus expired our first and only State bank.

A few years prior to the winding up of the Lombard Bank, viz. in 1836, the first South African joint stock bank, styled the Cape of Good Hope Bank, was founded with a subscribed capital of £700,000, of which £175,000 was paid up. The Cape of Good Hope Bank conducted business for over half a century, and had nine branches in the Cape Colony and four in the Transvaal. Owing, however, to the excessive and imprudent advances against gold scrip which it granted during the share "boom" of 1889, heavy losses were incurred, with the result that on September 20th, 1890, it suspended payment. Creditors of the bank lost little, as they received total distributions amounting to 19s. 7⅞d. in the £, but the shareholders lost all their capital, and, in addition, had to meet their unpaid liability on the shares. The same year saw the failure of the Union Bank, which was established in 1847 with a paid up capital of £75,000. This failure was also due to the violation of sound banking principles, and caused much distress to shareholders throughout the country.

It is worthy of note that between the years 1836 and 1862, inclusive, no less than twenty-eight banks, with a total paid up capital of little over £1,000,000 (an average of about £36,000 each), were established in the Cape Colony, all of which ceased to exist before the end of 1891. Fourteen of these institutions failed utterly, thirteen were absorbed by other banks, and one, the Queenstown Bank, liquidated without loss to shareholders or depositors.

At December 31st, 1911, there were seven separate banking institutions in British South Africa, with a total paid up capital of £4,796,925, and reserve funds amounting to £3,000,000. The fate of the fourteen banks referred to above is instructive, as they were all under the control of men on the spot, who were, in the majority of cases, personally acquainted with practically all their clients, and they should, in theory, have been successful. That they failed, and in most cases failed badly, is a strong argument in favour of centralisation in banking and the control of funds by an impartial management, on sound business principles, unaffected by local influence or sentiment, which, it is to be feared, entered too largely into the transactions of these unfortunate pioneers of banking in South Africa.

In the year 1861 the dawn of a new era in South African banking was signalised by the establishment of the London and South African Bank, the first institution to introduce British capital into banking in this country, and also the first bank to have its head office and directorate outside South Africa. This bank was absorbed in 1877 by the Standard Bank, which had commenced business in Port Elizabeth in the year 1863, and which also raised its capital in England.

The Bank of Africa was founded in 1879, and the African Banking Corporation in 1890, both institutions raising their capital in England and being controlled by London directorates. The oldest bank carrying on business in South Africa at the present time is the Natal Bank, which was established in 1854 with its head office and directorate in Pietermaritzburg. The National Bank is the only other institution of importance controlled locally, and was founded in 1891 by special

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Bills Discounted; Advances made against Security; Drafts Bought and Sold, and Letters of Credit issued on South Africa, Europe and elsewhere. Current Accounts opened and monies taken on fixed deposit at rates that may be ascertained on application at any of the Bank's branches.

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decree of the Volksraad of the late South African Republic. Its paid up capital was £502,000, which has since been increased to £1,100,000.

The chief feature in connection with banking in South Africa at the present time as compared with, say, fifty years ago is the decrease in the number of separate banking institutions. In 1861 there were twenty-five different banks in Cape Colony and two in Natal; at the close of 1911 there were, as previously stated, only seven separate banks in the whole of British South Africa. These seven institutions, however, have no less than four hundred and fifty-nine branches and sub-branches throughout the country, an increase of one hundred and ninty-nine during the last eight years alone. The conclusion of the negotiations for the absorption of the Bank of Africa by the National Bank, and subsequent assent thereto by the shareholders of the former institution, have resulted in a further decrease in the number of separate banks in the country. This event is one of the most important in the history of South African banking, and is a reversal of the usual order of things, which has hitherto been for the control of banking to pass from local hands to London directorates. When the liabilities and assets of the Bank of Africa are finally taken over by the National Bank, the latter will be a powerful institution with a paid up capital of £2,350,000, and a reserve fund of £370,000. The current accounts, deposits, etc., of the two banks, according to their balance sheets dated December 31st, 1911, amounted to £17,500,000, and cash on hand, securities, bills of exchange, loans, and bills discounted £19,378,000. The Standard bank, however, still retains the premier position with a paid up capital of £1,548,525, and a reserve fund of £1,960,000, whilst its current accounts, deposits, etc., at December 31st last were £19,142,055, and cash on hand, securities, bills of exchange, loans, and bills discounted amounted to £24,495,234.

Unfortunately, owing to the absence of statistics, it is impossible to quote figures showing the position of banking, as a whole, in South Africa twenty or thirty years ago, but the following particulars taken from a recent issue of the "Statist" show the progress made by the principal individual banks during the last two or three decades, and afford a striking illustration of the enormous growth of banking business in this country.

The chief feature revealed by the foregoing figures is the large increase during the past twenty years in the deposits, advances, and total assets of the banks in South Africa, a sure indication of the enormous development of the country during the period mentioned. The figures in the following table show the combined totals of all the South African banks at December 31st, 1911:

Liabilities to shareholders ...	£7,796,925
Note circulation	2,377,745
Deposits	44,391,453
Cash in coffers	7,371,616
Investments	4,557,103
Advances	40,635,732

It will be seen from the above table that the cash in hand held by our banks amounts to 16.6 per cent. of their liabilities to depositors, a proportion which

AFRICAN BANKING CORPORATION, LIMITED.

DATE	Capital and Reserve	Notes in Circulation	Deposits	Cash on hand at Bankers at Call and Short Notice	Investments	Bills Purchased.	Bills Discounted and Advances	Total Assets
30th Sept., 1895	£297,645	£33,870	£3,486,751	£1,382,037	£149,180	£1,127,381	£1,084.923	£3,843,147
30th Sept., 1900	470,000	109,956	3,034,194	1,125,888	328,794	687,082	1,354,378	3,650,c97
30th Sept., 1911	560,000	281,966	5,784,363	1,569,821	835,665	1,301,607	2,796,961	6,743,982

BANK OF AFRICA, LIMITED.

DATE	Capital and Reserve	Notes in Circulation	Deposits	Cash on hand at Bankers at Call and Short Notice	Investments	Bills Receivable, Bills Discounted	Loans and Advances	Total Assets
31st Dec., 1880	£250,000	£167,145	£1,396,355	£470,219	£18,100	£1,820.783	£191,059	£2,537,746
31st Dec., 1890	360,000	139,285	2,216,062	704,966	336,554	1,463,537	801,701	3,368.230
31st Dec., 1900	1,213,000	413,029	4,596,277	1,915,937	716.095	1,351,754	2,624,442	7,102,945
31st Dec., 1911	1,500,000	282,040	5,762,574	1,305,670	1,030,650	2,461,296	2,626,116	8,725,329

NATAL BANK, LIMITED.

DATE	Capital and Reserve	Notes in Circulation	Deposits	Cash on hand at Bankers at Call and Short Notice	Investments	Bills of Exchange on hand	Bills Discounted and Advances	Total Assets
31st Dec., 1895	£337,238	£126,164	£3,179,654	£2,177,658	£468,110	£113,421	£885,225	£3,875,529
31st Dec., 1900	404,238	89,769	2,747,650	1,347,594	269,061	106,369	1,521,747	3,460,286
31st Dec., 1911	825,000	121,596	4,518,755	1,272,266	257,081	509,954	3,585,519	6,302,159

NATIONAL BANK OF SOUTH AFRICA, LIMITED.

DATE	Capital and Reserve	Notes in Circulation	Deposits	Cash on hand, Bullion, etc. Money at Call and Short Notice	Investments	Bills Discounted, Advances, etc.	Total Assets
31st Dec., 1895	£763,700	£315,298	£4,728,182	£3,401,084	£714,225	£1,618,620	£5,972.051
31st Dec., 1900	1,148,900	278,558	1,188,229	579,867	596,700	1,285,768	2,836.162
31st Dec., 1911	1,170,000	521,424	10,669,320	3,281,296	646,868	8,032,612	13,767,086

STANDARD BANK OF SOUTH AFRICA, LIMITED.

DATE	Capital and Reserve.	Notes in Circulation	Deposits	Cash on hand at Bankers, Native Gold and Money at Short Notice	Investments	Bills Discounted and Advances	Total Assets
31st Dec., 1870	£414,350	£117,417	£510,881	£129,419	—	£1,370,011	£1,545,920
31st Dec., 1880	1,503,994	711,360	6,081,927	1,541,478	£344,996	8,882,798	10,888,235
31st Dec., 1890	1,550,000	768.060	8,918,169	3,206,407	1,240,054	8,965,543	13.608,196
31st Dec., 1900	2,450,000	1,253,684	16,978,865	7,059,062	3,323,841	12,820,046	23,423,522
31st Dec., 1911	3,508,525	1,165,472	19,189,753	5,596,110	2,774,233	18,403,343	27,367,183

compares favourably with that maintained by the banks of the United Kingdom, which, excluding the Bank of England, held at the close of last year cash amounting to £148,734,972 against deposits totalling £955,733,554, a ratio of 15.5 per cent. In view of the satisfactory record and position of the South African banks, it is surprising to find that even at the present time there are people who view banks with suspicion, and prefer to hoard their gold rather than deposit it with a bank. This is unfortunate, not only for the banks, but also for the country in general. All this hoarded money is so much unproductive capital, which, so far as the country is concerned, might as well not exist. If lodged with the banks, or similar institutions, it can be lent out and thus increase the productive capital of the country. The growth of education will, however, soon remove old-fashioned prejudices of this nature, and there is no doubt that within a few years, thanks to the opportunities afforded by the extension of branch banks throughout the country, that banking facilities will be availed of to the fullest possible extent by the people of South Africa.

The National Bank of South Africa, Ltd.

(Incorporated in the Transvaal)

Bankers to the Government in the Transvaal — **Bankers to the Government in the Orange Free State**

Subscribed Capital: £1,100,000 — **Paid Up Capital: £1,100,000**

With Power to Increase to £4,000,000 — **Reserve Fund: £120,000**

Head Office: PRETORIA



National Bank of S.A. Ltd., Johannesburg.

Board of Directors:
Hon. H. CRAWFORD, (Chairman).
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General Manager: E. C. Reynolds.
London Committee of Management:
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Acting Manager: D. Cunningham.
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P. F. R. de Villiers (Chairman).
A. G. Barlow, C. G. Fichardt, M.L.A., Ivan H. Haarburger, Hon. C. H. Wessels.

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Boksburg North
Brakpan
Carolina
Christiana
Cleveland
Clifton
Comet (E. Rand)
Davel (Agency to Ermelo)
Denver
Ermelo
Fordsburg
Germiston
Hartebeestfontein (Agency to Klerksdorp)
Heidelberg
Jeppestown
Johannesburg
Do. Commissioner St. East
Johannesburg, Harrison Street
Do. Pritchard Street
Kinross (Agency to Bethal)
Klerksdorp
Knights (Witwatersrand)
Krugersdorp
Lake Chrissie (Agency to Carolina)
Langlaagte
Leeuwdoorns (Agency to Klerksdorp)
Lichtenburg
Lydenburg
Machadodorp.
Maquassi (Agency to Wolmaransstad)
Maraisburg
Middelburg
Newtown
Nylstroom
Ophirton
Pietersburg
Piet Retief
Pilgrims' Rest
Potchefstroom
Potgietersrust
Pretoria
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Roodepoort
Rooiberg
Rustenburg
Sabie
Schweizer Reneke
Springs
Standerton
Sterkwater (Agency to Potgietersrust)
Treurfontein
Trichardts (Agency to Bethal)
Turffontein (Agency to Ophirton)
Val (Agency to Standerton)
Ventersdorp
Vereeniging
Volksrust
Wakkerstroom
Witbank
Wolmaransstad
Zeerust

Cape Province

Adelaide
Cape Town
Dordrecht
East London
Port Elizabeth
Somerset East
Strydenburg

Orange Free State

Bethlehem
Bethulie
Bloemfontein
Boshof
Bothaville
Brandfort
Bultfontein
Clocolan
Dealesville
Dewetsdorp
Edenburg
Excelsior
Fauresmith
Ficksburg
Fouriesburg
Frankfort
Harrismith
Heilbron
Hoopstad
Jacobsdal
Kestell
Koffyfontein
Kopjes
Kroonstad
Ladybrand
Lindley
Luckhoff
Marquard
Memel
Odendaalsrust
Parys
Petrusburg
Philippolis
Reddersburg
Reitz
Rouxville
Senekal
Smithfield
Steynsrust
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Trompsburg
Ventersburg
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Vrede
Vredefort
Wepener
Winburg
Zastron

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The Bank is prepared to grant Drafts and Letters of Credit, to make Telegraphic Remittances, to Buy and Collect Bills, and to undertake every description of Banking Business. Current Accounts opened and Fixed Deposits received, on terms which may be ascertained on application

The Wages Bill of the Mining Industry.

Mines in the Union Distribute Ten-and-a-Half Millions in White Wages in 1911

The following table of expenditure on salaries and wages of white employees on mines in the Union (for the year 1911) is taken from the annual report of the G.M.E. for 1911:—

Province and Classification.	Gold Mining Industry.					Diamond Mines.	Coal Mines.	Base Mineral Mines.	Lime and Flint Works.	Power Supply Companies (per se).	Total.
	Mines.		Reef and Alluvial Diggers.	Metallurgical Works and Tailings Works.	Total.						
	Witwatersrand.	Outside Witwatersrand									
TRANSVAAL—	£	£	£	£	£	£	£	£	£	£	£
Technical Staff*	764,153	88,514		4,588	875,255	22,593	46,060	26,554	3,171	20,226	975,859
Clerical Staff	382,167	21,572		1,607	405,346	30,589	20,231	7,024	1,637	15,243	480,070
Other White Employees	7,080,179	205,929	26,525	7,542	7,320,175	166,969	109,776	65,749	13,177	138,973	7,814,819
Totals	8,226,499	316,015	26,525	13,737	8,582,776	220,151	176,067	99,327	17,985	174,442	9,270,748
CAPE—											
Technical Staff*	—	—				60,995	2,969	11,176		—	75,140
Clerical Staff	—	—		—		45,872	1,518	4,900	No record	—	52,290
Other White Employees	—	—	1,830		1,830	643,099	6,889	24,373		—	676,191
Total ... ... £	—	—	1,830	—	1,830	749,966	11,376	40,449	—	—	803,621
ORANGE FREE STATE—											
Technical Staff	—	—				30,600	8,281	—		—	38,881
Clerical Staff	—	—		—		17,801	2,994	—		—	20,795
Other White Employees	—	—	5,120		5,120	215,275	18,704	—	622	—	239,721
Totals ... ... £	—	—	5,120	—	5,120	263,676	29,979	—	622	—	299,397
NATAL—											
Technical Staff*	685	—			685	—	28,935	120		—	29,710
Clerical Staff	240	—	3,193	—	240	—	14,710	—		—	14,950
Other White Employees	1,250	—			4,443	—	95,867	648	564	—	101,522
Totals ... ... £	2,175	—	3,193	—	5,368	—	139,482	768	564	—	146,182
UNION OF S. AFRICA—											
Technical Staff*	853,352	—		4,588	857,940	114,188	86,215	37,850	3,171	20,226	1,119,590
Clerical Staff	403,979	—		1 607	405,586	94.262	39,453	11,924	1,637	15,243	568,105
Other White Employees	7,287,358	—	36,668	7,542	7,331,568	1,025,343	231,236	90,770	14,363	138,973	8,832,253
Totals ... ... £	8,544,689	—	36,668	7,542	8,595,094	1,233,793	356,904	140,544	19,171	174,442	10,519,948

* Includes £52,259 paid in salaries to medical officers.

The Steiger Calculating Machine

"Millionaire"

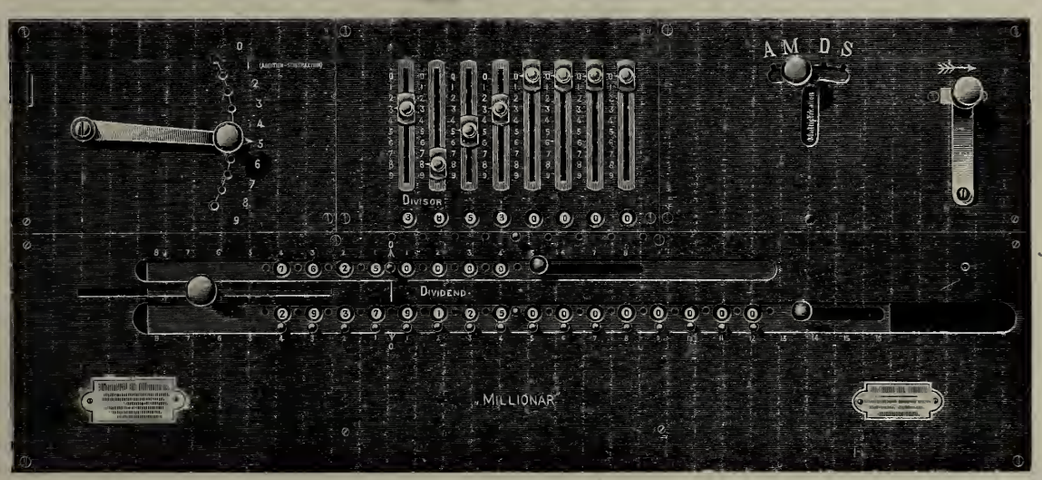
ADDITION — SUBTRACTION — MULTIPLICATION — DIVISION

MADE IN THREE SIZES:
SIX, EIGHT AND TEN FIGURE.

The only Calculating Machine that operates on the Multiplication Principle & consequently the FASTEST MULTIPLYING or DIVIDING MACHINE in the WORLD.

53,861,429 × 28,516,937 = 1,535,962,977,522,973 requires 7 to 8 seconds,

WITH ONLY EIGHT TURNS OF THE CRANK.



(Face of 8 figure machine.)

ADVANTAGES.

1. Only ONE turn of the crank is required for each figure in the multiplier or quotient, instead of one turn for each unit of each figure.
2. The carriage containing the multiplier and product rows, shifts AUTOMATICALLY instead of by hand.
3. The two factors always appear in two straight lines just above the product, thus affording an easy check on each calculation.
4. Any amount set up on the marker slides, appears in a straight line directly underneath, allowing an easy check by the operator.
5. A ten is carried over the whole line of the result: 9·999·999·999·999·999·999 + 1 = 10·000·000·000·000·000·000.
6. Wear and tear on all gear wheels about one-fifth of that in other calculating machines.
7. All parts interchangeable, and a stock always kept on hand.

Full particulars may be had from the AGENTS FOR GREAT BRITAIN AND THE COLONIES,

ADAM HILGER, Ltd., 75a CAMDEN RD., LONDON, N.W.

Machine Tools and Modern Methods

What They Mean in Economy and Efficiency *Messrs. D. Drury & Co.'s Enterprise*

IN mentioning the firm of Messrs. D. Drury and Co. one is primarily drawing attention to machine tools, and in speaking of machine tools one cannot get away from Messrs. D. Drury and Co., as that firm's supplies are on practically every mine on the Reef, and over the Transvaal and beyond it. Strict attention to business and giving a customer exactly what he wants, while not endeavouring to induce him to purchase particularly what the seller wishes to dispose of, have been their policy, and that, coupled with the fact that they carry the pick of the agencies for both American and English machine tool manufacturers, as a perusal of the subjoined list of but a few readily will convince one of the high-class character and the wide and varied range of stock the firm can supply users. In these particular supplies the success of the firm has been most outstanding, and they have secured a great proportion of the business in South Africa. By their enterprise and energy they have justified themselves in being the largest importers of this class of tools in the Province, and they can assure clients of immediate attention to their requirements. They advise anyone interested in these tools to make a point of inspecting them under test, for there need be no further argument than their indubitably established economy and efficiency under working conditions. Last year for Messrs. Drury and Co. was a very successful one, and the prospect is even brighter this year as most of the mechanical engineers along these fields are aware of the fact that cheap machines of antiquated pattern are a decidedly uneconomic proposition, and that the modern high-speed tool is the right and only thing.

Messrs. D. Drury and Co. are widely known for their progressive and reliable business methods. As they specialise in this branch of mechanical work, and as they have a very fine and comprehensive stock of tools, it certainly would be worth the while of every engineer to inspect it and thus keep himself in touch with the latest improvements which are proving such an important factor in the reduction of working costs. That they turn out the work so much quicker than by the older ways is an economy that should be considered, as it releases gear and equipment from being inordinately "hung up." They not only stock machine tools, but also every kind of big and small mining tools, such as chucks, drills, reamers of all required sizes and types, stationary stays, dies for bolts and pipes, vices, vee blocks—a whole gamut of necessities of the workshop.

Mr. H. B. Waite, one of the partners, has recently returned from an extended trip in Europe and America, and was able to bring back with him a valuable fund of information as to the application of the latest ideas in the world of mechanics. He also secured a number of new agencies. The following are but a few of Messrs. D. Drury and Co.'s agencies, but they serve to indicate the high-class and modern supplies with which they are able to provide their clients: Dean, Smith and Grace lathes, Geo. Richards facing, boring, drilling, and milling machines, Thwaites Bros. steam hammers, Mitchell's emery grinding machines, Hendey Norton lathes, Landis bolt threading machines, Gould and Eberhardt shapers, Saunders pipe threading machines, Cincinnati planing machines, Cincinnati milling machines, Catlin keyseating machines, Sibley high-speed drilling machines, Keighley Gas and Oil Engine Co. gas and oil engines, Drummond Bros. small lathes, Landis grinding machines, T. and R. Lees woodworking machines, Geo. Swift and Sons machine tools, La Pointe Machine Tool Co. broaching machines, Rahn Larmon lathes, etc.

Pneumatic Tool Progress

THE application of the Boyer and Little Giant pneumatic and electric tools for riveting, chipping, drilling, etc., is now universally acknowledged. On almost every bridge erection and steel construction work along the Reef, South Africa generally, and the world over, these machines have been extensively employed in conjunction with C.P.T. compressors, which are built for belt, steam, or electric drive.

The Boyer riveting hammer will close rivets up to one and a quarter inch diameter, while the range of pneumatic and electric drills of the Little Giant and Duntley type are capable of drilling holes in steel up to three inches. For close-quarter work, the Little Giant corner drill, having a capacity up to two inches, is a favourite machine along the Reef, and is intended to eliminate all hand ratchet work. The Duntley electric grinders, made in three sizes, are specially adapted for executing rock-drill repairs. Various other machines made by the same firm, covering a very wide range in labour-saving appliances, will be found most advantageous in all classes of steel construction work, bridge building, rock drilling, and for general use in engineering workshops.

The construction and design of these machines is based on an experience extending over fifteen years, and the firm's five factories in America and the United Kingdom are thoroughly equipped with the most up-to-date machinery for the manufacture of these specialities. Estimates and full particulars can be obtained from the Consolidated Pneumatic Tool Company, Ltd., 3 and 9, Cullinan Buildings, Simmonds Street, Johannesburg (Box 4921).

The Great Diamond Industry of South Africa

History of the Progress of De Beers, Premier, and other Diamond Producers

By HAROLD S. HARGER, F.G.S.

DURING the early nineties, when the "South African Mining Journal" was launched as a great and desirable acquisition to a rapidly expanding South African Press, its efforts were devoted mainly to the gold industry of the Transvaal, which was advancing with great strides and impressing the world with a sense of approaching greatness. There was no diamond industry in the Transvaal in those days, and any suggestion of diamond mines existing in the Pretoria district, for instance, would have been treated with scorn and contumely by the Kimberley man. The past twenty years have vastly changed all that, and the Transvaal is to-day the proud possessor not only of the finest gold industry, but of the greatest diamond mine in the world. In pre-war days, the world's demand for the precious gem was almost entirely met by the De Beers Consolidated Mines, but since the advent of the Premier Mine, South Africa has been more than able to meet all demands, a consummation not quite desirable in the diamond trade. The sudden expansion of the industry, due to the great Premier output, threatened serious consequences at one time, but the danger has been overcome by careful adjustment of the output; and under present controlling influences the future of the South African diamond industry looks more stable and promising than ever before in its history.

To fully realise the great value and importance of the diamond industry to South Africa, it is necessary to ponder over a few figures. It is only when one discovers that South Africa has contributed in forty years about one hundred and forty million pounds worth of diamonds to the world's stock of precious gems that one fully realises what such an industry means to the small community of whites in this country, and how much we owe to the wise policy of that great mining corporation, the De Beers Consolidated Mines, which raised the industry from the slough of despond to a state of soundness and financial security. Notwithstanding a greatly increased output since the war, due to the discovery of the Premier, Voorspoed, Roberts Victor, and other mines, the price of diamonds has also shown a marked improvement, and South Africa is now supplying the world with diamonds at the rate of £8,000,000 a year. "All for the vanity of woman," as Mr. Rhodes once remarked—"and the depravity of man!" as a lady piquantly added. Whether the shafts of dazzling radiance dispersed by the sparkling gems wound man or woman deepest need not be discussed here. Like the truant deeds of Eros, it may form fit subject for prosy and academical discussion, but affects not one whit the De Beers shareholder, who may smile complacently when he bears in mind that the De Beers Company have paid £35,000,000 in dividends, and that the two historic mines known as Kimberley and De Beers alone have yielded gems of the value of £60,000,000 during the past twenty-three years. Moreover, when it is remembered that these two mines are the smallest of the group, and that there is ten times their original area awaiting attack in the other known payable mines of the country, the pandering of man to the vanity of the fair sex of the future is fully assured and provided for. The great De Beers Corporation, which employs seventeen thousand five hundred natives



Bird's-eye View of the Premier Mine.

and three thousand five hundred whites, is an institution which deserves the best wishes of the entire population of South Africa, for diamond mining is but the nucleus of their great work, which extends throughout the land to beyond the Zambesi, and includes as branch enterprises the manufacture of dynamite, fruit growing, stock raising, and dairy farming, railway expansion, etc. Their excellent mining work in the past, and far-sighted policy have at last, and very rightly, given them the control of the entire diamond industry of this country, a consummation which will surely redound to the lasting benefit of the industry they have so ably served and built up. As a result of this achievement,



The Deepest Open Mine in the World: Kimberley Mine, Open Depth 1,000 feet.

the interests not only of the producer, but of buyer and seller, will be carefully upheld, and the future of the diamond market assured within all reasonable necessity. The importance of this can only be realised when the extensive nature of diamond mining operations is clearly grasped. There are at present nine important payable mines in South Africa, capable conjointly of producing over £8,000,000 value in diamonds annually; or, in other words, as much as the world can take. Five of these form the Kimberley group, but the operations of De Beers are to-day mainly covered by Dutoitspan, Wesselton, and Bultfontein. The De Beers mine was closed down during the crisis year (1908) and has not yet been re-started, whilst the Kimberley mine is no longer a factor of any importance in the diamond market on account of its greatly reduced size. The Kimberley mine, the richest and great historic mine of the world, is now working at a depth of three thousand five hundred feet, but is only one-tenth of its original surface area. The blue ground, once soft and easily pulverised on exposure to atmospheric influences, is now much too hard for the floors and must be treated direct. It is not only the deepest working diamond mine, but is the deepest open mine in the world, being over one thousand feet deep in the open. Some remarkable and interesting changes have taken place in the Kimberley and De Beers mines during the past twenty years worth recording. When the consolidation of the mines was effected in 1889, the average grade of Kimberley and De Beers together was over one carat per load, whilst Kimberley alone was over one and a quarter carat per load. From that time the average has constantly dropped until last year it was only .28 carat per load. There has, however, been a marked change in money values in an inverse ratio, the price of diamonds won having been raised from 19s. 8d. per carat in 1889 to 51s. 6d. per carat in 1911. The trend towards a lower average yield appears to have been largely due to impoverishment in the De

Beers mine—a factor beyond anyone's control, whilst the compensating advance in values has been solely due to the fine organisation and clever manipulation of the diamond market by the De Beers Company and the Diamond Syndicate in which it is so largely interested. In 1907, prior to "the crisis," the advance had been even greater, Kimberley and De Beers stuff having averaged no less than 64s. 9d. per carat, an appreciation of two hundred and twenty-five per cent. on the price ruling in 1889, when Rhodes' great amalgamation scheme reached maturity. These are achievements which stand out boldly and creditably when the work of the great Kimberley mining corporation is closely examined, and every other mine is benefiting to-day in a corresponding degree. .When the "South African Mining Journal" came into existence, the companies then working in Dutoitspan and Bultfontein were unable to pay their way; to-day they are making handsome

WESSELTON.

Average yield per load	...	.27 of a carat.
,, value ,,	...	10s. 2d.
,, ,, per carat	...	37s. 9d.

The output in 1911 from the entire De Beers group of mines was 2,180,000 carats; the average value, 45s. 9d. per carat; the value of the output being nearly £5,000,000. The magnificent results which have been obtained for many years past have led to great developments. Last year the company were able to declare no less than sixty million loads of blue ground in sight above lowest working levels, and nine million loads of blue ground on the floors. This alone is more than the output of the De Beers and Kimberley mines during the past twenty-three years. What then of the future? Brilliant indeed, who will gainsay? But great changes lie in the lap of the future. As depth increases, *size decreases*, and a continuation of the present big



The largest Open Mine in the World: The Premier Mine looking North.

profits, and Dutoitspan, the poorest in caratage, is proving to be the richest in money value per load on account of the much-needed inflation in values. In 1911 the following results were obtained:—

DUTOITSPAN.

Average yield per load	...	.21 of a carat.
,, value ,,	...	15s. 5d.
,, ,, per carat	...	73s. 6d.

KIMBERLEY AND DE BEERS.

Average yield per load	...	.28 of a carat.
,, value ,,	...	14s. 5d.
,, ,, per carat	...	51s. 6d.

BULTFONTEIN.

Average yield per load	...	.38 of a carat.
,, value ,,	...	13s. 3d.
,, ,, per carat	...	35s. 0d.

output can only be accompanied by a relatively more rapid exhaustion of the mines. For that and other good reasons the control of this great mining corporation has been extended, either directly or indirectly, to all the big payable mines of the country. On the surface, the claim area of the De Beers group aggregated 3,762 claims, divided as follows: Kimberley, 470; De Beers, 622; Bultfontein, 1,067; Wesselton, 1,162; and Dutoitspan, 1,441 claims. Owing to the contraction of the pipes with depth, the combined area of these mines at their lowest working levels is considerably below that of the Premier mine, near Pretoria, which has an area of 3,482 claims. The number of loads still to be mined by the De Beers group, however, runs into such huge figures that for the next few decades the company should comfortably be able to meet all demands on its resources. The changes that will

probably interest us most in the near future will not concern mine ore reserves or market values, but mining practice. There are several important factors which call for a cessation of the old flooring methods, and the introduction of the direct treatment system which is in vogue at the Premier. The increase in the hardness of blue ground in the deeper levels; the more lengthy period of exposure on the floors thus made necessary; the corresponding increase in capital outlay caused thereby; the facilities for theft of diamonds afforded by the old flooring methods are all factors which combine to make direct treatment desirable. In other words, the mind's eye can see the old historic "floors" of Kimberley disappearing, and the many square miles of country once covered with blue ground reverting to red weed-grown veld. The great and important change in mining practice which will bring this about has been largely influenced by the success of direct treatment, and what it has taught, at

The Premier Mine.

This great Pretoria mine has broken all records by being the largest mine, having yielded the largest and finest diamond the world has ever seen, treating the greatest quantity of ground, producing the largest number of diamonds, and generally doing everything on the biggest scale ever attempted. By its gigantic size, three thousand four hundred and eighty-two claims, it leaves the second largest South African mine (Dutoitspan) a long way behind. By its enormous annual output it has even threatened the supremacy of the great De Beers Company, and stands to-day a leading factor in the diamond world, steered by brains which have made their influence felt and respected by the other mental giants of the industry. A stubborn fight with its great Kimberley opponents has terminated in a clearer atmosphere, followed by a settled policy of mutual respect and fair play, and the great Pretoria diamond mine continues its stupendous operations with a clock-like precision which bears the impress of faultless administration. The labours of such men as Sir Thomas Cullinan and those two great moving spirits acting in concert with him, namely Messrs. P. Ross Frames and Adolph Wagner, would fill an instructive and absorbing volume, and their work has pulled the great Premier through its trials triumphantly and set it on a sound foundation for the benefit of the country and posterity. With its huge claim area, equalling seventy-three English acres, this majestic diamond pipe has surprised the world from many points of view; and if one could ascertain the number of diamonds it is capable of turning out before the limit of deep mining is reached, the diamond world might quake. A saving feature of such an output, however, lies in the fact that only a small percentage of the stones produced are of good gem quality—a most fortunate provision of nature against what would otherwise be a suicidal super-abundance of natural wealth. On account of its great size, it is anticipated that the Premier mine will be worked in the open, as at present, to a depth of fifteen hundred feet, which will represent the removal of five hundred million loads of ground. The time occupied in this enormous piece of work will be forty years, by the treatment of twelve million loads annually, to loosen which from its solid state six miles of holes must be drilled daily. Those twelve million loads should give the world two and a quarter million carats of diamonds a year, and yet will only lower the depth of the working levels forty-three feet. The present average depth is one hundred and forty-nine feet, and in bringing the mine down to this level since its discovery 45,707,568 loads had been treated up to September last, yielding 12,187,451 carats of diamonds! To carry out such work the machinery erected is capable of doing fifty-five thousand loads per day of twenty-four hours, and to drive it all engines of seven thousand horse-power are necessary. Needless to say, an enormous quantity of water is required to supply such a plant, and the four triple-expansion engines which drive the ram pumps are able, when called upon, to force four million gallons of water daily through twenty-three miles of piping at the ridiculously low cost of two pence per thousand gallons—a lesson which the Johannesburg citizen, who pays five shillings and sixpence per thousand gallons, may well take to heart! To keep this great mine at work day and night, eight hundred white men and eleven thousand seven hundred natives are required, to say nothing of the brain toll demanded of such men as Mr. P. Ross Frames (the managing director), a worthy South African who is doing big things for a great mine, with the aid of that able De Beers veteran, Mr. W. McHardy, the company's manager, whose son makes an invaluable assistant. Although the Premier does not rank with the other



Opening Up Diamond Paddock, Pniel Estate

leading mines in the quality of its product, it is in advance of all others, not only in the extensive nature of its operations, but in mining practice also. The Premier, indeed, has never ceased to experiment and improve from the day of its inception. It leads the world in actual practice to-day—not because the great De Beers, with its vast experience, is asleep, but because necessity has been the instrument which so quickly shaped the way to greater things, aided by the type of brain power which devours every opportunity of performing the possible best.

Past and Future Practice.

The result of the ten years' work at the Premier indicates pretty clearly how diamondiferous ground will be treated in the future. The days of the old rotary washing pan are numbered, as also is the flooring system. The successful treatment of ground direct, which Mr. Thomas McLelland has endeavoured for twenty years to demonstrate, is an accomplished fact—thanks to the pioneer's culminating effort at the Premier. Direct treatment at the present day consists of two systems: one retaining the old rotary pans, the other adopting pulsators for washing the ground. Both are highly successful, and the future will doubtless see the pulsator washing machine in general use. Some tests at De Beers have recently proved its infinite superiority over the old rotary pan, and in practice it is probable the pulsator will give fully a twenty-five per cent. better result than the rotary pan. In the course of time the pulsator as a washing machine will doubtless be installed at all mines for the direct treatment of blue ground. The system is no new one, for its merits were realised and put to the test in a big way by the De Beers Company more than twenty years ago, though not brought to finality and perfection at the time. At last, however, it has got beyond the stage of theory and experiment, and has come to stay. The value of this method of direct treament has been further enhanced by the introduction of tube mills. At the Premier the tube mill is primarily used as a concentrator, and greatly lessens the work of the grease tables by grinding to sand the pebbles and heavy minerals retained by the "wash up" pulsators. But the tube mill promises to be of great assistance for another purpose also. It has been proved in many mines that diamonds are frequently coated. This applies especially to mines such as Wesselton, Koffyfontein, Bultfontein, and others, which



Diamond Mining8in German South-West Africa

being used on a big scale at the Premier, and although different in design, are based alike on the principle of direct double-treatment by which the flooring of blue ground (still indulged in by the De Beers Company, Jagersfontein, and Koffyfontein) is obviated. The first big plant has a capacity of twenty thousand loads a day (twenty-four hours) and retains the rotary pan. The process is briefly as follows: The rock is first reduced by gyratory breakers to two and a half inch fragments, and then passes to four-foot ribbed rolls, which further reduce it to seven-eighths of an inch. It is then washed in the first set of pans, the concentrates going to a "wash up" pulsator and the tailings to the next set of rolls, which are of the smooth type and six-feet diameter. These reduce the ground to three-sixteenths of an inch, after which the process of washing and pulsating is repeated. The second, or later plant, has a capacity of thirty-five thousand loads a day. Whilst retaining the same types of crushing machinery, it eliminates the rotary pan, the washing being done entirely by pulsators which reduce the ground to one per cent. of its original bulk. The concentrates are further reduced by tube mills, and then finally passed over grease tables of the frue vanner type. This method of treatment has proved have had a capping of calcareous tufa. In such mines, the diamonds are often completely coated with a thin shell of lime, and when in that condition there is a poor prospect of their being recovered either by the grease table or by hand. At Koffyfontein this has been carefully noted, and for some years the sortings have been floored like blue ground for the purpose of weathering off the lime crusts which have so effectually prevented the recovery of many diamonds in the past. In addition to lime-coated diamonds, there is always a prospect of some of the stones being sealed up in the fragments of blue ground and eclogite so frequently seen in the concentrates of a washing machine, and these would likewise be released if passed through a tube mill, which in certain cases should prove to be a useful adjunct to any modern washing plant. The direct double-treatment of ground by the pulsator, apart from its value as a diamond winner, promises to have an important bearing on the future of the industry in another direction. Hitherto the treatment of "hardibank," and any other form of hard blue ground, has been looked upon as impracticable. To-day De Beers is treating "hardibank" direct by crushing and double washing in pans, but to form the necessary "puddle"

the pans must be loaded with old tailings during the process. The pulsator washing machine will overcome all such difficulties, so that the discoverer of a "hardi-bank" mine in the future will have nothing to fear provided the ground is rich enough to pay for the cost of treatment.

Amongst the recent departures in diamond washing may be mentioned the direct double-treatment plant installed at the Voorspoed mine. In this case pans are used, and pugmills take the place of rolls. For the treatment of yellow ground the pugmill gave satisfactory results, but in comparison with rolls as a crusher of blue ground it is quite outclassed and is not likely to figure again in any up-to-date plant.

One other piece of mechanism which promises to play an important part in our great diamond industry is a recent invention known as the Flottmann drill. This little machine, which is small, light, cheap, and highly efficient, promises to do wonders in diamondiferous blue ground. Several have been thoroughly tested at the Premier mine with most gratifying results. This excellent little air drill, which is capable of drilling a six-foot hole in four minutes in tough blue ground, is easily handled and worked by one native, and is as simple as it is effective. When the Premier mine is fully equipped with these drills, it is expected that four thousand less boys will be required to do the same amount of work as hitherto. When a drill such as this can be widely used in the gold mines of the Rand, the native labour problem will have been simultaneously solved.

As a result of twenty years of ever-inproving practice, it may be said with confidence that any kind of kimberlite can now be successfully treated by direct methods; that the pulsator washing machine, aided by crushers, tube mills, and grease tables, can win a higher percentage of stones than any other known system has ever done, and may be the means of converting some of the hitherto unpayable mines into quite payable propositions.

What the Other Mines are Doing.

Outside of the De Beers group and the Premier, the Jagersfontein mine stands first in importance. Having been the first dry mine discovered, it is perhaps commensurate with its historic status that it should produce diamonds of finer quality than any of the other great mines. Having no less than eleven hundred and twenty-four claims at surface, the mine also ranks as one of the biggest in the country, and this feature, coupled with the good dolerite walls which encircle it, has enabled "open" work to be carried on to a depth of six hundred and fifty feet. As "open" work at Jagersfontein is now a thing of the past, the mine is being rapidly developed on the underground system. Although this system is more costly than open working, a larger number of loads can be mined by the former methods, and that should to some extent counteract the great rise in working costs which must otherwise result from the change. Whether this splendid mine will in the future be able to make nearly half a million a year profit, as it has done in the past, remains to be seen. Possibly a rise in the price of Jagersfontein diamonds may be engineered which will be commensurate with the higher working costs ruling, and thus equalise the position. The administration and general management have been so excellent in the past that shareholders may still expect big dividends and look the future in the face complacently. For many years past the mine has been run very successfully on the old-time methods of flooring and washing in rotary pans, so that there is nothing striking to record in the way of new ideas at Jagersfontein.

Another big Free State proposition which has lately come to the fore as a profit-earner is the Koffyfontein mine. After twenty years of struggling, it has emerged



The Premier Mine: A working face showing slickensides due to the process of Serpentinisation

from the slough of despond into the sunshine of payability, a change for the better due solely to the policy of raising prices inaugurated by De Beers. The Koffyfontein mine has a surface area of twelve hundred and seventy-five claims, and is a five and a half carat proposition, with diamonds worth about sixty-eight shillings per carat. It is the cleanest and nicest mine to work in South Africa, possessing as it does very soft and clean blue ground, and having no float reef or other troubles to combat in the mine. As it is still within three hundred feet of the surface, it appears to have a long and prosperous life before it. Its work continues on the old lines, the same as at Jagersfontein, and its working costs are lower than those of any other big mine in the country. Its little brother, the Ebenezer

as one big concern. The dual area would then be two thousand claims, and form the second largest diamond proposition in South Africa.

Another large mine which has been in full swing for over five years is the Voorspoed mine, near Kroonstad. This mine, with its eight hundred and five claims, has been working in a big way, treating one and a half million loads a year and winning some two hundred and fifty thousand carats in the same period. Since its inception, the Voorspoed has given the world almost one million carats of diamonds. The ground is mined from four levels, the lowest of which is one hundred and ninety feet below the surface. Direct double treatment is in vogue, the crushing being done first by big gyratory crushers, and then by sixteen large pugmills, whilst the



Plan of Voorspoed Diamond Mine

mine, is but a couple of hundred yards away, a mine of eight hundred and one claims, contemporaneous in origin, and from all points of view geologically a similar type of mine. Situated on the same line of fissuring, having precisely the same minerals and exotic rocks, and the same class of diamonds, it was not surprising that a determined effort was made to prove its payability. At the eastern, or Koffyfontein, end of the mine—which is shaped like a human foot—the values were expected to prove about the same as in its bigger relative, viz., five and a half carats per hundred loads, but the western end has, in the past, given much lower results near the surface. If the average came within the range of payability, one more large mine would join the list of producers. Apart from its ability to run on its own, the mine, had it been payable, could be linked up with its neighbour, and the two be worked

washing is done by sixteen fourteen-foot pans, having a capacity of four thousand loads a shift. The pugmills not being of high enough capacity for the pans they are serving, will have to be replaced by rolls to secure a bigger output before very substantial profits can be expected. The result to the end of 1911 (five and a half years' work) gave an average of 16.7 carats per hundred loads, a figure which should be improved upon when more suitable crushing machinery is installed.

Since the foregoing lines were penned, the Voorspoed mine has been acquired by the De Beers Company, which has guaranteed a small annual dividend to shareholders, and the mine has been closed down.

Three other mines are amongst the steady producers of the Free State, namely the Roberts Victor, Eland, and Blaauwbosch. All are small mines, consequently

they are small producers. They belong to a rich little group in the Boshof district, and on account of their good yields have greatly stimulated prospecting enterprise in that district.

The Frank Smith, near Barkly West—a district renowned for its beautiful diamonds—is yet another mine which will shortly add its quota to the South African output. This mine (which absorbed the old Windsor) is erecting new direct treatment machinery on the very latest ideas, under Mr. T. McLelland's directions. The plant will consist of crushing rolls and pulsators of similar description to the No. 4 Premier plant, but will have a number of improvements in its details, and is expected to form

The Show Plant of South Africa.

It will have a capacity of four thousand loads a day, and being a great improvement on the old fashioned rotary pans, should enable the mine to give better results than it has ever done before. The diamonds are of exceedingly good quality, and consequently should find a ready sale at all times.

The foregoing does not quite close the list, for the old Otto's Kopje is again at work striving with strict economy to pay its way; whilst Kamfersdam, near Kimberley, and the Montrose (Pretoria) are each to receive a new lease of life in the shape of fresh capital, and will doubtless leave no stone unturned to make up for past failings.



Work on the German South-West African Diamond Fields.

Our Advance in Geological Knowledge.

Our knowledge of kimberlite and its origin has advanced very materially during the past twenty years, and it is due directly to the science of geology that several diamond discoveries have been made since the war. In "the nineties" the fundamental importance of the fissure and its relationship to pipes was not understood. In cases where fissures or lines of weakness had been found, they were treated with the utmost contempt by the so-called prospectors of the period; and the very mention of the word fissure was sufficient to condemn a property without further discussion. To-day its importance is recognised and admitted by all. It may, indeed, for practical purposes be accepted as a geological law that all diamond mines occur on lines of weakness; and as a consequence every fissure should be carefully followed in the effort to locate a mine. In many instances mines, the existence of which was not even suspected, have been found solely through conforming to this law, and many more will doubtless be discovered if assiduous attention is paid to this important fact by the prospector. The work done on these lines in the past ten years has taught us much about kimberlite, and shows that our mines are both volcanic and igneous, but more frequently of the latter origin. The kimberlite of the normal fissure, and likewise of the smaller mines, which are merely swellings or enlargements of the fissures, is an igneous intrusive rock, whilst the diamonds found therein are primary constituents of that rock. Most of the larger mines are volcanic pipes or necks filled with a serpentine breccia which usually differs in structure from the original kimberlite found in fissures and their enlargements. As regards the age of the pipes, the evidence available shows that they are generally younger than the fissures on which they occur, but this is not a rule. The Kimberley mine had a fissure or dyke of kimberlite passing through it which was of later date than the pipe; and at Voorspoed (to quote a unique case) one fissure is older and a second cross fissure younger than the pipe. It is, moreover, worth noting that whereas the fissures have facilitated the intrusion of the pipes, in no known case has a pipe caused the formation of the fissure to which it is related. There is also a noteworthy difference in the types of vulcanism which have formed the diamond mines. Whereas the smaller mines or fissure enlargements appear to have been formed by a single intrusion followed by a final choking of the vent and cessation of action, such does not always appear to be the case with the volcanic pipes. In other types of volcanoes it is well known that long periods of quiescence have been followed by renewed outbursts. There is no reason why the same should not have occurred in some of the kimberlite volcanoes. The Voorspoed mine is a case of exceptional interest in this respect. It is, in the first place, a volcano within the neck of a pre-existing volcano, having been formed on the site of a diabasic volcanic neck. There is, moreover, strong evidence of this mine having been subjected to a secondary eruption of kimberlite, as the east central portion is totally different from the remainder of the mine, and the condition of the boulders of the second eruption points to a more severe and prolonged type of vulcanism than the earlier portion had experienced.

A feature of considerable geological interest in many diamond mines are the "soapy veins" or slickensides so frequently met with. Though remarked from the earliest days on account of the danger of a sudden subsidence of adjacent ground, it is only in recent years that the probable cause of these slickensides has been ascertained. In the Premier, Montrose, and Voorspoed mines the slickensiding is very remarkable owing to the

numerous parallel planes which occur, the faces of which are at times highly polished. At the two last-named mines there are numerous horizontal planes curved in the form of arcs. These are in reality pressure planes formed by an uplift of the ground beneath. At the Premier a number of slickensides occur parallel to one another, and these dip at varying angles in different parts of the mine from forty-five degrees to the vertical, but no arc-like pressure planes were noticeable. The writer is indebted to Mr. P. Ross Frames for an excellent photograph showing the slickensiding which has occurred in the southern section of the Premier mine. An example which still better illustrates the nature of the movement was seen by the writer on the highly polished faces of a great solid mass of Waterberg sandstone which stands on the east central side of the mine. Here the serpentinous faces of the slickensides present a somewhat fibrous appearance due to the stealthy grinding movement of the kimberlite against the sandstone, the fibres being plucked off abruptly at the upper ends, thus pointing to the upward movement of the blue ground long after its intrusion at the earth's surface. This movement is due to the process known as serpentinisation, a process of hydration or absorption of water which induces the alteration of ferro-magnesian silicates, such as olivine and certain pyroxenes, into serpentine. A result of this change is expansion of the rock mass, causing enormous pressure, which, taking the direction of least resistance, moves upwards. The angles of the slickensides indicate that the mass did not always move vertically, but must have squirmed about in various directions, always, however, culminating in an upward movement. The arc-like pressure planes seen at the Montrose and Voorspoed mines are doubtless due to the same cause—the pressure exerted by underlying masses of blue ground expanding during the process of serpentinisation, and slowly seeking relief and space for its increased bulk in an upward direction.

The writer has seen precisely the same result due to the serpentinisation of a mass of gabbro in the Lydenburg district, and the process is to-day well known and understood by geologists. In most cases where slickensiding is noticeable in rock masses, the cause is due to subsidence or settlement of the formation in a downward direction, but in the case of kimberlite it is usually the reverse.

Finally, it may be observed that explorative work during the past two decades has proved that kimberlite may occur not only in any formation in Africa, from the Jurassic downward, but in any part of the world, the diamond-bearing rock having already been found in every continent. It has, moreover, been proved that kimberlite is not the only matrix of the diamond, but that diabase and dolerite also at times carry the precious gem. Quite recently, in the Pretoria district, the diamond has been found in what appear to be ultra-basic segregations from an acidic volcanic breccia, thereby widening the field for research and further establishing the desirability of broad-mindedness in matters geological.



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Johannesburg—Past and Present

By W. SMALE-ADAMS
(Secretary of the Johannesburg Chamber of Commerce)

From *JOHANNESBURG TO-DAY*

JOHANNESBURG occupies a unique position in the list of cities of the world whose growth has been rapid in character. Twenty-five years ago the land on which it stands was bare and uninhabited, and might have even now merely been included in the area of isolated farms had it not been for the advent of the enterprising prospector.

From the records of the late "Mining Argus" it appears that in the early part of 1886 the local population consisted of a small camp of Europeans (including Colonel Ferreira and Messrs. Wemmer, Wolhuter, De Villiers, Fox, Sonnenberg, and Rimer) and a few native servants. The beginning of our great mining industry is traced to the Brothers Struben, who set up the first battery at Wilge Spruit in the year 1885. During succeeding months the arrivals included Messrs. J. G. Bantjes, J. B. Robinson, William Knight (who formed the first company on a large scale), P. Whitehead, and others.

The area was proclaimed as a public digging by the late President Kruger in the "Staats Courant," in September, 1886. The population then numbered some fifty souls, whose surroundings were far removed from the luxurious. The first comers lived in tents, wagons, mud-walled huts with tarpaulin roofs, and reed shanties; and they ate from iron pots in which meat and vegetables were compounded together into a sort of broth. There were, of course, no roads, and they had to put up with heavy rains and swamps—huge holes making it dangerous to move about at night—while in the dry season there were dust storms far thicker than those experienced in recent years, and of which we think we have reason to complain. The trying nature of these conditions was, however, rendered endurable by the spirit of friendliness and sociability which subsisted—besides, of course, the buoyant hope of success by which these pioneers were animated.

Reference may be made in passing to the origin of the name of the town. It is popularly assumed that it was named after Mr. Johann Rissik, who was at that time Surveyor-General, but it is stated that when the Government of the South African Republic proposed to lay out the town, Mr. Rissik was asked his opinion as to a suitable name, and he suggested Johannesburg for the reason that the name Johannes was borne by both President Kruger and General Joubert, the most prominent men in the Republic. It will be observed that the original streets were principally named after the old officials and pioneers.

No time was lost after the proclamation in the development of the town. With the rapid opening up of mining operations there was a concurrent advent of traders—first from the coast towns, and afterwards from further afield. And in September, 1887 (but twelve months after the proclamation) the "Mining Argus" described the conditions in the following enthusiastic outburst:—

"In all sober earnestness we assert that the history of Johannesburg is unparalleled in the history of towns. This time last year the site on which it stands was bare of everything in Nature which indicates life. The soil on which the foundations of the place are set did not produce sufficient of any life-giving thing to keep a respectable family of butterflies on the wing. The place had neither habitation nor name; now a town occupies the ground, which, in the solidity of its buildings, its institutions, its trade and commerce, its social and domestic arrangements excel any town covering the same measurements of ground in this country. It has stores, shops, hotels, banks, insurance offices, and corporate bodies of various kinds as well conducted and doing as much business, and doing it as well as similar institutions in any town of the British Empire."

The first recorded sale of building sites took place in December, 1886, when prices varied from one shilling to £280 per stand. As against this record, it is interesting to note some prices obtained in recent years, such as a corner plot in Rissik Street, £40,000; two corner stands in Market Square, £45,000; four stands in Eloff Street, £110,000, etc.

AN EXAMPLE OF SOUTH AFRICAN HANDICRAFT.



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In the matter of buildings, however, the original ideas were not of an ambitious nature—for in the laudatory article of the "Mining Argus" already referred to, there is the admission that: The Landdrost's Court is of wood and canvas, the Gold Commissioner's and other offices of iron with lean-to's added on as extra clerks are required; and the 'tronk' (prison) of a mixture between sods and bricks, with stone buttresses to prevent the ruinous-looking mass from falling to pieces."

During the last twenty years the town has been rebuilt and few of the original erections remain. The later buildings, particularly since the war, will bear comparison with those of the other large towns of the world.

From the commercial standpoint, the town has, in its advancement, kept pace with the development of the mining industry, and manufacturers oversea, and the farmers and producers of South Africa have here found a most valuable market. The mercantile community has laid itself out to meet the conditions to such an extent that local stocks are kept which more than equal any present requirement, whilst for future needs there are at hand representatives of practically all the leading manufacturers of the world.

For the household and personal requirements of the population there is a liberal provision and that healthy competition which affords assurance to the purchaser that he is obtaining value.

Of course, the proximity of Johannesburg to the mines lends to it great importance as a commercial centre; but apart from this, a very large wholesale trade is done with retail traders in practically all parts of the Transvaal.

The conditions described have resulted in the erection of very large wholesale and retail stores.

In concluding this brief review and to sum up the present position of the town it will probably be of interest to quote a few statistics from the Mayor's Minute for 1910. These figures are sufficiently significant to indicate the importance of what is recognised as being the commercial capital of South Africa.

Land	£14,303,905
Buildings	13,016,370
	£27,320,275

The Loan Stock stood at £5,500,000 in four per cent. Inscribed Stock, repayable in 1933-4.

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SALES CONDUCTED IN THE MART AND AT PRIVATE RESIDENCES. Cash Settlements on Day of Sale

The capital expenditure out of Loan Funds includes :

Expropriated Area	£1,150,000
New Town Hall and Site	350,000
Sewerage Scheme	460,000
Stormwater Drainage	280,000
Electric Supply and Gas	830,000
Tramways	700,000
Water Supply	300,000
Road Construction	610,000

Estimated ordinary expenditure for financial year 1911-12... ... ... £686,202

Estimated revenue, 1911-12 ... ... £716,972

Approximate revenue of Trading Departments, 1910-11 :

Gas and Electric Supply	£69,634
Tramways	45,254
Water Department	25,774
Market Department	18,908

The Assessment Rate (at 2½d. per £) realised approximately £291,455 for 1910-11.

Area of townships, 20,286 acres.

Length of streets, 667 miles.

A Notable Cape Commercial House

Adolph Mosenthal & Co., Port Elizabeth

IN reviewing the commercial industries of the Cape Province, unless some adequate reference were made to Messrs. Adolph Mosenthal and Co., this work would be incomplete. This firm, who are importers, exporters, bankers, agriculturists, industrialists, and mine owners, have taken part in nearly every movement for progress during the past seventy years in the sub-continent. The founder of the firm, the late Mr. Joseph Mosenthal, arrived in South Africa in 1839. Shortly after his arrival he was joined by his brother, Mr. Adolph Mosenthal, and their first business was started at Graaff-Reinet. Later, their headquarters were transferred to Capetown, and in 1860 they established themselves at Port Elizabeth, where the headquarters of the firm have remained ever since. Greatly due to this may be traced the gradual increase in importance of this port, all movements for progress having received their personal support and help.

At the early date afore-mentioned, the trading requirements of the country were extremely limited, and it is, indeed, a wonderful record of progress steadily persevered in which has resulted in the gigantic undertakings that represent the firm's interests here to-day. Great interest has been taken by Messrs. Mosenthal in all South African produce, Mr. Adolph Mosenthal being the first to introduce the mohair goat, on account of its valuable product, into South Africa. The benefits of this are best shown by quoting the first year's shipments of mohair in 1857, which then totalled 1,870 lbs., and which had in 1910 increased to nearly 20,000,000 lbs. The same interest has been taken by them in the ostrich feather industry, and it is largely due to their efforts that the Port Elizabeth market was raised to its present important position. Lectures and pamphlets epitomising the most expert knowledge on both wool and mohair, as well as ostrich feathers, have been freely given and circulated by them, and the enormous quantities of South African produce which pass through their hands to-day are doubtless the effect of their earnest endeavours to get the best results obtainable from the country.

As regards their merchandise stocks, huge departments, replete with the carefully sought products of the world's principal industrial markets, are to be found here, there being no class of trade existing in the country for which they do not cater.

With the discovery of gold on the Witwatersrand, the firm turned their attention to this, and established their headquarters in the Transvaal at Pretoria, as had been previously done at Kimberley at the diamond fields. The results of their interests in these undertakings can be deduced from the fact that the present senior partner of the firm is a director of De Beers Consolidated Mines, Ltd., and also of the Rand Mines, Ltd. They are also interested in the Jagersfontein mines. Mr. Harry Mosenthal is also a director of the Atlas Assurance Company, Ltd., and the Marine Insurance Company, Ltd.

In the early days of their business, the firm issued their own notes, but on the establishment of banking institutions this practice was discontinued. In the course of years, with the gradual growth of their business, branches have been opened at many up-country and sea-port centres—at Kimberley, East London, Pretoria, Johannesburg, and Delagoa Bay. Messrs. Mosenthal and Co. are also managers of the Bechuanaland Trading Association, the pioneer commercial concern of Rhodesia, and here, again due directly to their efforts, can be traced considerable progress in the north, as their operations extend to Ngamiland.

The London house was opened in 1856. The present heads of the firm are Messrs. Harry, George, and William Mosenthal—the three sons of the late Mr. Adolph Mosenthal.

The firm act as agents at Port Elizabeth for the Bucknall S.S. Lines, Ltd., London ; the Ellerman and Bucknall Joint Service ; American and African S.S. Line, Ltd.; American-Australian S.S. Co., Ltd.; Natal Direct Line (Bullard, King and Co.) ; and Stephan Brothers' coasting steamer. Outside these lines of shipping companies, the firm represents the Marine Insurance Company, the Atlas Assurance Company, Nobel's Explosives Company, Glasgow and Hamburg ; Companhia de Moçambique, Beira ; R. A. Lister and Co., Ltd. (sheep and goat-shearing machinery and petrol engines) ; Limpopo Ranching Company, Ltd., and other important concerns.

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Rising South African Industries

Soap and Candles :: Enterprise of the New Transvaal Chemical Company, Limited
A Praiseworthy Object Lesson in Local Industry

AS a typical study of what colonial industry can achieve, the record of the New Transvaal Chemical Company, Ltd., shows us results that firms who have had lesser obstacles in the way of progress and advancement could be justly proud of. The inception and past successes of the company are to-day the common property of all those who are interested in the industrial development of the Union, but it is well to dwell upon those capabilities which have so far been successful in combating the numerous obstacles that all new enterprises have to overcome in a new country; and the energy, enterprise, and organisation shown by Dr. Scheslinger and the directors of the company are worthy of all praise. The benefits that accrue to the country by the industries that are established therein are not, at first thought, apparent, but to the discerning mind the fact that such industries are in being is a great factor in reducing the cost of the article manufactured; because the competition engendered between the colonial and oversea manufacturers will eventually reduce the cost to the public of any such article that is required for consumption. The New Transvaal Chemical Company, Ltd., who largely manufacture soaps and candles, which are the necessities of life, are, therefore, responsible for the lowering of the cost of these articles, through their successful endeavours to compete with the overseas manufacturers. The works of the company at Delmore are equipped with the most up-to-date machinery, and are capable of turning out the very finest class of work; the staff of employees number several hundreds, and the works cover a frontage of half a mile. The employment of such an amount of labour and capital can only be considered as a valuable asset to the country, and the demand that is necessarily engendered for the raw material required for manufacturing purposes, to be grown in the country, serves the purpose of enlarging the scope of benefits that must accrue to the State.

Wherever possible, only matter and material that can be procured and grown in the country is used in the manufacture of the company's products, and it is interesting to know that a great percentage of the materials used in the finished article is locally produced; even in America (a country teeming with Nature's gifts, which are so suitable for manufactures) only some fifty per cent. of material used is of local production. The company, therefore, deserve the generous patronage of the public to support them in their efforts. For many years the company have placed on the market candles of every description and variety, suitable for every purpose—mining, household, commercial, and ornamental—and the knowledge and experience of their staff of chemists have created qualities suitable to the peculiar temperature and climatic variations of this country, and to-day their candles stand pre-eminent in value and popularity. The demand for locally manufactured soaps has been met with the usual versatility of the company, and after exhaustive experiments with reference to the conditions of the waters of the country, soaps that have no equal are on the market. To-day their famous Surprise soap is in use in every home, and the other brands manufactured by them are in equal demand. The exceptional capabilities the company have of manufacturing products that are essentials of use in the home, etc., have resulted in the placing on the market of a disinfectant, "Antiseptol," which, in all ways, meets the demand for such an article, and which has been proved to give satisfaction when other brands have failed. Great strides have been made in the manufacturing of artificial manures, and every class of manure has been manufactured for the special requirements of the nature of the growth and soil under cultivation. The company are willing at all times to give their help and experience in this matter to the farmer and those who are requiring information.

The Chemical Company have the control and working of the famous Seltzbach Springs, situated at Van der Merwe, Transvaal, and have placed the natural mineral water on the market. This water has wonderful recuperative qualities, and is largely used in cases of malarial and rheumatic tendencies; that the water is of the very best quality and absolutely pure has been proved by the analysis recently conducted by Drs. J. Loevy and Pakes, Government Analyst and Bacteriologist respectively, who describe it as being free from the slightest trace of any organic substance, and, owing to the presence of natural bicarbonates, it has a palatable and refreshing taste. Anti-friction greases are another of the many varied products that have the attention of the company, and the importation of oversea greases has largely decreased since the introduction of the company's greases on the market. The consolidated efforts of the company in manufacturing has tended to the use of local natural products, which, in the ordinary way are generally considered worthless, and it is the aim of the company in every direction to encourage and use any local product or industry in their manufactures. In conclusion, it is not too much to say that, in every way, are generally considered worthless, and it is the the existence of such energy and capabilities in our midst can only tend to the increasing prosperity of the country.

RAND MINING IN PICTURE



A View at the Bantjes

Rand Capital Expenditures

A Study in Millions :: Mines Comparable with Dreadnoughts :: Eight Mines Record a Total of Thirteen and a Quarter Millions

IT has been truly said that a modern Rand mine in point of expenditure is comparable with a Dreadnought. Few adequately realise the vast sums of money necessary to bring a Witwatersrand mining proposition, and especially one with deep shafts, to the stage of production. Some facts and figures, culled from a few balance sheets recently issued, should, therefore, prove of considerable interest.

Notwithstanding the impracticability of giving exact comparisons, some interesting statistics may be advanced as to the cost of sinking shafts in and developing and equipping some of the newer and most modern mines.

A Necessary Consideration.

The amounts expended depend, of course, very largely on the extent of the property, the depth at which reef lies, and the size of milling and treatment plants. In considering the statistics appended, it should be borne in mind that the majority of Witwatersrand mines were originally laid out with a view to expansion of operations, and therefore of plant. Many concerns, especially the older mines, have attained to the zenith of their production, but nearly all the newer installations have been designed on bases which will admit of extension. One cannot, therefore, obtain a fair and equitable capital expenditure per stamp factor of comparison for the mines here dealt with. The Cinderella Consolidated, for example, has erected one hundred stamps and three tube mills, whilst the capital expenditure incurred to date has amounted in round figures to a million and three-quarters. The intention is to increase the capacity of the plant to one million two hundred thousand tons per annum and to two million five hundred thousand tons per annum at a later date, and on these larger expenditures the amount expended per stamp or per claim will be substantially less than on the present basis. Similarly, the City Deep mine has been laid out with a view to extension, and so have Modder B., the Village Deep, and, in fact, the majority of the concerns dealt with hereunder. After this necessary preface, we will proceed to deal with the capital expenditures incurred by a few mines which have recently completed new plants.

Expenditure Analysed.

The Randfontein Central, possessed as it is of the largest milling installation on the fields, had spent up to the end of last year over two millions sterling on shafts and development, and close on two and three-quarter millions in respect of machinery and plant. General equipment at the City Deep has cost double what has been expended on mine development and shaft and mine equipment, the figure for the item of expenditure included in the former being £827,923, and for the latter £415,738. These proportions are more or less maintained in the capital expenditure of the Modder B., where, up to the end of last year, development had called for £295,932 and equipment £495,463. On the other hand, the Village Deep Company has spent substantially more on shafts, shaft equipments and development (£675,237) than on equipment (£617,217). Of the three shafts of this company, the Turf Mines vertical—the deepest shaft on the Central Rand—has, of course, claimed by far and away the largest amount. The Bantjes has paid out over £400,000 for equipment, and spent a quarter of a million on development. Brakpan Mines expenditure figures at £935,316 in respect of shaft sinking and equipment—£16,790 "compressors" and £194,383 on development. The total expenditure of the Simmer Deep, where a number of deep shafts were sunk, on companies now included in the amalgamation scheme, amounts to over £2,100,000. Shaft sinking at cost stands at £584,298, and unredeemed development at £459,876, making a total of expenditure "below ground" of £1,044,174. The charges in respect of equipment of property, less amounts written off, total £1,078,174.

An Impressive Total.

In the following table are stated the totals of capital expenditure incurred by these mines up to the end of last year. The aggregate sum for the eight mines concerned amounts to no less than £13,760,211, or an average of £1,720,026 per mine :—

Randfontein Central	£4,789,023
City Deep	1,243,661
Village Deep	1,292,454
Modder B.	791,395
Bantjes Consolidated	658,514
Cinderella Consolidated	1,716,327
Brakpan Mines	1,146,489
Simmer Deep	2,122,348
	£13,760,211

WHAT THE RHODESIAN MINES BUY

Steady Growth of Mining Material and Stores for Mining Purposes in 1909, 1910 and 1911

THE following list shows the value of the imports of the principal mining materials and stores into Southern Rhodesia during the years 1909, 1910, and 1911. The particulars are taken from the official statements :—

	1909.	1910.	1911.
Assay apparatus ...	£3,638	£7,216	£9,552
Candles	22,895	27,574	28,521
Cement	6,143	7,384	10,364
Coal	47	...	...
Coke and patent fuel ...	882	1,331	1,265
Cyanide of potassium ...	14,056	10,035	8,364
Cyanide of sodium ...	19,325	20,905	23,473
Detonators and fuse ...	13,738	18,995	16,125
Dynamite, etc.	53,453	79,193	73,310
Electric fittings	6,971	11,661	15,295
Grease, antifriction ...	2,401	2,780	3,704
Iron and steel	55,970	89,023	96,386
Lead	477	469	19,641
Lime	2,357	2,585	3,392
Machine oil	10,242	11,185	12,855
Machinery—Electrical ...	7,231	11,822	5,982
Machinery—Mining ...	134,575	182,502	185,670
Native foods	34,294	19,459	12,541
Quicksilver	3,232	2,659	3,351
Ropes, wire	3,416	7,281	6,286
Salt, common	2,454	2,613	2,864
Wood	20,188	30,917	51,808
	£417,985	£547,589	£590,749

The Cyanide Process on the Rand

An Historical Sketch, being mainly Personal Reminiscences of the Progress of the Cyanide Process on the Witwatersrand since 1891

By WILLIAM BETTEL

A METALLURGIST, who visited these fields in 1892 and returned here twenty years later, could hardly have been more impressed by the amount of original work done by chemists and metallurgists in connection with the chemistry of gold extraction processes during that period than was the writer at the extraordinary advances made in the hydrometallurgy of gold during one-tenth of that period, i.e., between the date of his first visit to Johannesburg in 1890 and that of taking up the position of chief chemist to the Robinson Gold Mining Company in 1892.

The Rand in 1890.

In 1890 the Rand was a typical mining camp, the outstanding features being the scarcity of water during the winter season, the arrangements in use for conservation of the limited water supply, the numerous heaps of more or less slimy tailings, and the water dams, into which, after amalgamation and concentration, the mill pulp flowed, more or less muddy water being taken from the lower ends by the mill-water feed pumps. On the larger mines the slimy water was further settled in auxiliary water-storage dams. The pits or dams speedily became filled with sand and slime, and had to be periodically cleaned out, the material, then considered as waste (but possessing a potential value in the event of a process which would cheaply extract the values—as shown by fire assay—being discovered and adopted), was stacked in the handiest places, so that the summer rainstorms could, with as little inconvenience as possible, remove what they would to the nearest watercourse or vlei to make room for further material dug out of the too-rapidly-filling dams. Needless to say, concentration was relied on to collect in an enriched form the gold not caught by amalgamation, and roasting, followed by chlorination, was considered to be the only feasible process by which the gold could be recovered from the rich concentrate collected.

Various processes were, from time to time, brought forward, but when put to the test of practical experience failed to establish the virtues claimed for them by enthusiastic inventors.

One need only refer to fine grinding (Adair and Cruikshank), which process recovered a considerable amount of the coarser gold in the tailings but failed, mainly owing to high working costs; continuous (or semi-continuous) amalgamation in Wheeler pans and settlers, the Molloy process, Julian's processes, to say nothing of the marvellous scheme detailed in one of the Transvaal newspapers, which was to employ sulphuric acid and fluor spar to volatilise the silica as silicon fluoride, leaving the pyrites and gold as a rich concentrate which was to be subsequently treated by a mystic —or mythical—wet process! Float gold, as the gold passing into the finer portion of the mill pulp was called, was both a mystery and a bugbear to the mining people on the Rand. It was a new experience to most mining men, and it worried them. When the inventors of the cyanide process came to the Rand with a wet process which, it was stated, dissolved gold from subdivided ore in a form more stable than the ordinary well-known gold salts, which was so independent of ordinary aids to extraction—such as roasting—that it could treat tailings direct from the mill or water dam, if sufficiently permeable for leaching, and challenged the supremacy of roasting and chlorination processes in the treatment of concentrates; further, unlike the chlorination process, the mother liquors or waste solutions, after removal of their gold contents, could, after strengthening up with fresh cyanide, be used for dissolving the gold from fresh charges, small wonder that mining men generally received all these statements with incredulity, and the difficulty of introducing the new process seemed well-nigh insuperable. Added to this incredulity was the unfortunate fact that the Cassell Company were the owners of the MacArthur-Forrest cyanide patents, and the knowledge of the dismal failure of a process which had been so well boomed and from which so much was expected, i.e., that of the Cassell-electro-chlorination process, was so recent that the breakdown of the new process in some essential point was generally expected. It is not surprising, therefore, that the "pups" of the Cassell Company (The African Gold Recovery Syndicate, later the African Gold Recovery Company, Ltd.) were able to make good terms with mining companies for treatment of their accumulations of tailings, etc., and were for some time able to successfully demand a substantial royalty for the use of their highly successful cyanide process. How the canny Scots were eventually worsted is "another story."

In the various experimental trials successfully carried out by Mr. J. S. MacArthur, aided by his staff, Mr. Alfred James, the engineer for the Cassell Company, Mr. Feldmann, chemist and metallurgist, and a small army of assayers and operators, the original idea of agitation with propellor-shaped agitators of the mixture of cyanide solution and crushed ore, concentrates, or tailings, and subsequent filtration under reduced pressure, was abandoned in favour of direct leaching. Square wooden vats with pebble beds supporting the filtering

cloths, and wooden shovelling strips were generally used, the leached residues being discharged over the sides of the vats into trucks running on lines laid parallel to the rows of leaching vats. One of the engineering staff designed and erected elliptical vats with upright staves and tightening straps, but the curious forms these vats assumed after use and the impossibility of keeping them watertight led to the discarding of both the vats and the subsequent services of their introducer. Mr. Feldmann designed a side-door discharge which had some considerable vogue. But the writer is getting ahead of his story. The small plant erected at the Robinson Mine by the African Gold Recovery Syndicate and skilfully managed by the chemist, Mr. G. A. Darling, to whom every credit is due for the careful working of a newly-introduced process, was successful from the start. After the first clean-up, which was considered very satisfactory, the African Gold Recovery Company, Ltd., was floated, and in 1891 the Robinson Company decided to take over the old plant and work their tailings by the new process under an agreement with the company owning the patent rights for the Transvaal. Mr. Butters, the company's metallurgist, had erected a modern chlorination plant at the Robinson Mine, which, for economy of working, simplicity, and neatness of design, was undoubtedly a model to be copied. The directors asked Mr. Butters to design a new cyanide works, as his ideas regarding the handling of crushed material seemed at that period to be greatly in advance of those of other metallurgists on the fields. As the writer remarked, in an article written in 1902: In 1891, when strong solutions of cyanide contained 0.8 per cent. KCy and weak solutions 0.4 per cent., when Prussian blue gave trouble, and slime still more when top and side discharge and square tanks were *de rigueur*, it required some courage to design, without any scientific knowledge of the process, an entirely new style of plant for cyaniding tailings, such as was designed by Charles Butters. From his experience in vat building in chlorination works in America, he built circular wooden vats, employed a modification of his bottom discharge (which an unkind barrister declared was as old as Adam), an apparatus which is in use throughout the world with but slight modifications. . . . Mr. Butters, for a non-scientific metallurgist, did wonders up to about March, 1892, when a lot of very acid, slimy tailings from settling dams upset all his calculations, and the writer was engaged by Mr. Hermann Eckstein . . . . to carry out researches to aid Mr. Butters in his work. . . .

1892 and After.

During these researches the writer was able to reduce the working strength of the cyanide solutions from 0.8 per cent. for strong solutions to 0.25 per cent. KCy, and lime was used in place of caustic soda, resulting in the reduction of consumption of cyanide from about 3 lbs. per ton (2.8—3.2) to 0.6 lb. KCy per ton—and under. Incidentally, it was found that the use of caustic soda instead of lime increased the consumption of cyanide by favouring the oxidation of pyritic matter (mainly marcasite, with traces of copper, cobalt, and nickel sulphides) and the formation of ferrocyanides, etc., and by increasing the action in the zinc boxes, which resulted in the formation of an undue proportion of alkaline zinc cyanide. In these days one had personally to devise process for analysing working cyanide solutions, as the literature of the subject was extremely scanty. With solutions containing free hydrocyanic acid, coloured brown or reddish brown from ferric sulphocyanate and ferric cyanide, the brown products of decomposition of cyanide, or from the interaction of HCN and HCNO—azulmic acid—the presence of other compounds of cyanide decomposition of unknown or uncertain composition, the absence of analytical processes which could be relied upon to give even moderately accurate results, were sources of great worry and tribulation to a chemist who had to work in an assay office scantily furnished with apparatus. To illustrate the difficulties the writer had to contend with, and as showing the absurd parsimony of some company directors, the writer requisitioned a platinum basin (value at that time about £5). As all articles over a certain value could not be ordered without the directors' sanction, this order had to go before the board of directors for consideration. After waiting for eight months, the writer was informed that the mine (capital two and three-quarter millions sterling) could not afford this expenditure! (Needless to say, this incident did not occur during the lifetime of Mr. Hermann Eckstein, whose memory the writer holds in the greatest respect.) As a result, after mentally apostrophising his superiors as several kinds of adjectived fools, the writer purchased the platinum dish on his own account. Ye gods! imagine a chemical laboratory without platinum apparatus! Evidently the operation of making bricks without straw was not confined to ancient times. That most eminent chemist, the late Professor R. Bunsen, must have been greatly worried by such superior cattle when he gave utterance to his famous aphorism that a chemist should be able to drill with a plane and plane with a drill. In spite of drawbacks (one of which was the close proximity of a residue dump to the balance room) several useful methods of analysis were devised and others placed on the stocks until the personal possession of a well-equipped laboratory would enable good work to be done. The peculiar behaviour of alkaline zinc cyanides in aqueous solution was one of those problems of dissociation or hydrolysis which had to be shelved and a weird formula provisionally given to a certain strength of the salt in aqueous cyanide solution for calculating the approximate percentage of "available" cyanide. Not fully realising that the addition of water to a solution being tested altered the chemical nature of some of its constituents, several "chemists" out for self-advertisement fell foul of the writer, declaring that the process he had published for the estimation of "available cyanide" was, in effect, so much piffle. These criticisms were passed over with a smile at the cocksureness of youth. (It is unnecessary to remark that the process is now, and will be until ousted by a more perfect process, in use in the writer's laboratories, and has afforded him much useful information in technical investigations, but it must be used—as the artist mixed his colours—with brains.) To resume the thread of the story. After the troubles caused by Prussian blue and those due to excess of slime, the presence of acid, and the careless use of caustic soda had been rectified or



Slimes Settlement with Lime.

W. Bettel's Experimental Plant at New Primrose Gold Mining Company, 1894. Note the launder at right hand lower corner—under water, the overflow being stopped to raise the level of the clear water—Messrs. E. H. Johnson, Strangman Hancock and Harry Miller near the writer. Compressed air pipes, air agitators and raft with foot valve and pipe connected to pump to remove water below level of launder to surface of settled slime.

avoided by the writer, Mr. Butters turned his attention to the treatment of slimy sands, and, by harrowing the surface, sun-drying, and mixing the fine material with more leachable tailings, was enabled to treat these semi-leachable sands with very good results. Large shallow collecting pits, with tram rails laid in the direction of their length, and slat-gate overflows somewhat after the Cornish style, were next introduced by Mr. Butters, the overflow being led into slimes settling dams to be accumulated for future treatment. Mr. Butters by this time had, by his ingenuity, fertility of resource, and energy, attracted so much favourable attention that the consulting engineer (who, following the traditions of his tribe, desired to secure to himself the "kudos" for all originality of his subordinates) grew jealous, then wild, and Mr. Butters naturally, as a man with an American reputation as a skilled metallurgist, did not submit tamely to the persecution—for such it was. This was the real reason of Mr. Butters' resignation from the Robinson, and was the cause of the formation of the Rand Central Ore Reduction Company promoted by Messrs. Goerz and Co. and managed by Mr. Butters for some years, until present political troubles, and the prospect of more on the horizon, led to the removal of the most enterprising and energetic metallurgist the Rand has ever known to a new sphere of activity in America. Mr. Butters has made a fortune through his enterprise in the cyanide industry. Good luck to him! Dr. Simon, an excellent chemist, consultant to the Eckstein group, carried out in 1892-3 a series of experiments based upon B. Molloy's hydrogen-amalgamator, and devised an electrical precipitation box for recovery of gold and silver from working cyanide solutions. A plant was designed and erected to treat an accumulation of old tailings and the electrical precipitation process installed. Unfortunately, the area of the mercury-sodium-potassium alloy was too small to ensure effective precipitation (up to ten dwts. of gold remaining in the cyanide solutions leaving the boxes), and the alkali-metals were too energetic in other directions—they precipitated other elements, iron, zinc (from auxiliary zinc precipitation boxes), and other elements, rendering the resulting amalgam too impure for effective work. (Subsequently, at the Robinson Deep, Mr. Zerener tried a process of his own of passing a shower of mercury containing sodium amalgam, prepared electrically, produced by passing the fluid amalgam through a perforated large mica sheet, against an ascending column of cyanide solution. The same troubles—iron and zinc in the resulting amalgam—were experienced, and terminated the trials.) The failure of this precipitation process resulted in the abandonment of this electrical method of precipitation and led to the re-introduction of the zinc precipitation process. Simultaneously with this work, Dr. Simon conducted some experiments at the Salisbury mine on direct filling, with the same style of plant as used by Butters at the Robinson—i.e., with slat-gate overflow, but in which the "automatic Kaffir with the hose" came to play an important part in Rand cyanide work. The battery pulp was led into a crude form of spitzlütte, the overflow going to slimes storage dams, the underflow to the direct-filling vats. Owing to the irregular nature of the filling, the close packing, the undue percentage of slimes in various parts causing impermeable layers, the extraction results were far from satisfactory. After Dr. Simon left the Rand, his researches were carried on by the late Mr. H. Forbes Julian, and at the Crown Reef by Mr. J. R. Williams. There is abundant evidence that lumps of sands assaying up to six dwts. gold per ton were found at the base of the residue dumps at both the Salisbury and the Crown Reef mines, emphasising the imperfect nature of the process, predicted by Mr. Butters, the writer, and others. Prior to Mr. J. R. Williams' connection with the Crown Reef, that metallurgist designed and erected a large cyanide plant (brick and cement vats) at the Langlaagte Estate, the discharge of tailings being effected by cranes and grabs, finally by lowering truck bodies into the vats. The truck bodies, when filled, were raised by cranes, deposited on their carriages, and removed to the dump by mechanical haulage. Mr. Williams also introduced cyanide treatment of concentrates. In connection with the treatment of concentrates by some person an amusing incident is narrated. The tonnages and assay values of concentrates treated in a certain run were recorded, clean zinc, it was stated, was used in the extractor boxes, and all the zinc dissolved in the final clean up, the fine gold recovered exceeded, by twenty-six per cent., the assay value of the concentrates, while the concentrate residue assayed, on the average, nine dwts. per ton! Whether the tonnage was underestimated or the assayer was to blame is not known, but in another case where Mr. G. A. Darling and the writer were twitted by Captain Mein, who wanted to know why a certain metallurgist could get ninety-one per cent. recovery from tailings, while the Robinson only got sixty-seven per cent. (three days' treatment), the writer was led to make an investigation which proved that the mine assays of the original tailings were two to two and a half dwts. too low, as were also the residues—a most unpardonable piece of slipshod assaying. The actual extraction was only sixty-six and two-thirds per cent., against the mine's returns of ninety-one per cent. In cases where "unaccountable discrepancies" between theoretical results and actual returns came to the writer's professional knowledge thereafter, he invariably investigated the methods in vogue on the mine for sampling and assaying. Without exception, these discrepancies disappeared when the samples of sands and residues were properly taken and carefully assayed, and the tonnage returns checked independently by suitable and well-known methods. Mr. Williams then started experiments on current slimes treatment by centrifugal pump circulation with cyanide solution. The slimes from the battery were collected in inverted pyramid-shaped dams connected to pumps placed in an excavation below the level of the discharge-openings of the dams. As no provision was made for accelerated settlement, the overflowing water was allowed to pass into other catchment pits or dams, a milky effluent escaping to the return water dams. The turbid gold-bearing solution obtained from treatment of the slime was filtered through sand filters, and the more or less clarified solution passed through Siemens and Halske's precipitation boxes. At the same time, Mr. Charles Butters, at the Rand Central Ore Reduction works, was carrying



W. Bettel's Experimental Slimes Plant, Primrose Gold Mining Company, 1894.

Precipitation boxes for precipitation of gold from weak cyanide solution by local electrical action. "Zinc-lead," "zinc-copper" and "zinc-carbon" couples were all tried. At right of photo pipes for conveying compressed air for agitation and discharge of slimes are seen.

out his experiments on accumulated slimes treatment by mechanical agitation.

Lime Settlement of Slimes.

One of the principal troubles experienced was that of imperfect settlement. The writer discovered in the course of a research in 1892-3 that float gold carried away in slimes could be recovered by adding to the slime pulp milk of lime equal to ten grains of lime per gallon of pulp, and all mining men who saw the experiment performed—men who had seen every known process of gold recovery—declared the process to be new. On this basis, a process, now universally used, was devised by the writer for slimes settlement and decantation of the clear water, as follows :—

1. Settlement of float gold and accompanying slime by additions of lime and agitation of pulp, somewhat after the method of sewage treatment by lime.
2. Continuous separation of clear water from the settled slimes (after a preliminary settlement of sand in settlers), and collection of slimes in a large conical-shaped dam large spitzkasten until the slimes commence to flow away with the effluent. (See photos with description.)
3. Decantation of surplus water (by floating syphon and centifugal pump).
4. Pumping sludge into tanks and dissolving the gold with weak cyanide solution (waste wash 0.02 to 0.04 per cent. KCy from sands plant), with use of compressed air for aiding solution, followed by circulation in launder by centrifugal pump. "Trough lixiviation."
5. Decantation of clear solution.
6. Precipitation in ordinary zinc boxes with local electrical action. "Zinc-lead," "zinc-copper," and "zinc-carbon" couples were all tried. (See photo of boxes.)
7. Feed of regenerative solution at head of box, cyanide at that time being too expensive, caustic soda was used, occasionally with irregular results.

The late Captain Mein, general manager of the Robinson mine, was sceptical as to the writer's ability to treat the whole of the pulp from a mill. At the Robinson in 1893, he remarked to the writer: "You may clear a bucketful, but I don't see how you are going to clear a damful of slimy water, Mr. Bettel." In 1894, Captain Mein and Mr. Webber (late general manager of the Rand Mines) called to see the writer's experimental plant at the New Primrose (see photos), and saw one of the largest slimes dams (not shown in photos) crystal clear. Captain Mein was astonished and delighted, and with a smile turned to the writer, giving him a hearty smack on the shoulder, said: "By G——, Bettel, you've done it. I didn't think you could." A large number of mining men called to see this novelty —for such it was in those days. Reference has been made to the inability of Mr. Charles Butters and Mr. J R. Williams to secure slimes settlement. The use of lime for neutralising acidity was known, but the employment of an excess (represented by the ten grains of lime per gallon of pulp) was quite unknown. Early in 1894, the writer, accompanied by a friend, visited the Ginsberg mine, and their mutual friend, the manager, the late Mr. John Gluyas. After visiting the mine, they were shown the cyanide works, and were told that the slimes flowing away assayed from seven to twelve dwts. gold per ton. The writer, relying on a provisional protection which had been granted by the Boer authorities, showed Mr. Gluyas how to clarify the effluent water and collect the slimes with lime, to that manager's astonishment and great delight. Mr. Butters, who was superintending the mill and cyanide works for the Rand Central, shortly afterwards, seeing the clear water running away, asked Mr. Gluyas how he had effected the settlement of the slimes. Oh, that's Mr. Bettel's process. How does he do it? He uses lime. But we use lime in the battery, and we don't get settlement. Well, Mr. Butters, I suppose Mr. Bettel uses more lime than you do. I suppose that's the secret. According to Mr. Von Gernet's statement before the State Attorney in 1895, he (Mr. Von Gernet) had dug pits in the slimes dam at the Worcester mine and settled slimes with lime on a date subsequent to that of the experiment at Ginsberg above narrated. The lawyers in whose hands the application lay, omitted to file the final application at the proper time and were forced to file a new application. This application was filed, it seems, after the trials above referred to by Mr. Von Gernet for Mr. Butters. Prior use was, therefore, pleaded with success. This technical flaw and the omission to mention that the process was one for collecting float or finely divided gold in battery slimes in suspension in water, led the then State Attorney to decide that the process was not new and was practically one for softening and clarifying water (Clarke's process), a process adopted years ago in Europe. The experiments, conducted at considerable expense by the writer in his trials of the process, were thus thrown open to the public, who readily availed themselves of the process. It may easily be imagined that the writer cordially agreed with the immortal Bumble in his opinion that "the law is a hass."



Birds-eye view of W. Bettel's Experimental Slimes Treatment.
Plant with Lime Settlement, 1894, Primrose Gold Mining Company. (Rose Deep Shaft in background.)
(Messrs. E. H. Johnson, Strangman Hancock, Harry Miller and W. Bettel in picture.)

Abandonment of Pebble Filters.

In 1892, the writer abandoned the use of pebble filters, substituting the wooden supports and laths used at the present day. This innovation was rapidly adopted and is now universally employed. The first vats to be fitted with these wooden grid supports were those of the new cyanide works at the Robinson mine. Shortly after this, December 14th, 1892, the writer gave a public exposition of his new process of slimes treatment (using potassic mangani-cyanide as an accelerator) with cyanide solution and separation and washing of the slimes cakes in a filter press. The method was some two or three years afterwards used in Western Australia (but without the accelerator), and on some plants is still in use. In the early nineties—the exact date the writer is unable to ascertain—Messrs. Pearse and Bowness treated slime by making it into bricks, drying, then stacking and burning in brick kilns. The burnt bricks were then crushed and cyanided, giving good returns which yielded a handsome profit on the venture in spite of the heavy consumption of chemicals. As may be imagined, the slimes were rich in gold.

Encased Gold.

In 1893, the directors of the Robinson Gold Mining Company requested the writer to continue the research, instituted by Mr. Charles Butters the previous year, upon the treatment of (Robinson) concentrates by cyanide. Mr. Butters had been treating five tons of "four-ounce" concentrates with a two per cent. solution of cyanide by continuous percolation and circulation (by means of a small boiler-feed pump), but using an enormous excess of caustic soda. Only about twenty per cent. of the gold had been extracted when Mr. Butters resigned his position at the Robinson, and the new chlorination works manager, Mr. Olive, had the partially treated concentrates dumped in a corner of the leaching house of the chlorination works, and these were exposed to the oxidising influence of the air, which was certainly not retarded by the chlorine always present in that part of the works. On application for a parcel of fresh concentrates, the writer was informed by the directors (who seemed to be embued with a concentrated spirit of business acumen—natural to them, no doubt) that he must take over the residues above referred to. These were deep blue in colour (Prussian blue), very acid, requiring, as ascertained by analysis, 33 lbs. CaO per ton of dry concentrate to neutralise the acidity. The writer made numerous trials, and found that the more slimy portion of the partially-treated concentrate assayed fifty-one dwts. per ton, and, although this material would easily pass a fine silk sieve equal to, say, four hundred meshes per linear inch, no ordinary treatment would dissolve the gold. As no grinding plant was available, the obvious plan of grinding with coarse quartz-sand residue was not adopted. Strong solutions of cyanide, cold and hot, with or without oxidising agents or accelerators, were used. The highest extraction obtained was eleven dwts. Some of this residue, well washed by decantation, was placed to one side and covered with weak lime water. Two samples of this material were treated, one with sulphuric acid and the other with hydrochloric acid, and left overnight. In the morning the cause of the trouble seemed to be (and as it proved, actually was) revealed. The vessels containing the acid-treated slime were quite dark-coloured with ferric salts. The necessary experiments were then made to ascertain the amount of sulphuric acid necessary to dissolve the basic ferric salts, and the bulk of the concentrate-slime residue was then subjected to the acid treatment. When all the iron oxide appeared to be dissolved (as shown by taking a portion of the pulp, washing with dilute H_2SO_4 by decantation, and finally with water, then testing for ferric salt by digesting with HCl which then showed by the colour that only a trace of ferric salt remained), the mass was washed by decantation with water, finally a weak alkaline wash was given, the mass drained under reduced pressure, a sample taken for moisture and assay, the remainder weighed, agitated for half an hour with a measured amount of cyanide and some sodium peroxide. The cyanide solution was assayed, and after calculation to ascertain the dry weight of material treated and the dilution of the solution by water in the moist material, it was found that over ninety-eight per cent. of the gold contents had been dissolved, proving that the coating had been a colloidal film of ferric hydrate upon which cyanide had no effect and through which it could not penetrate. As the cost of acid would have proved prohibitive, except in the case of very rich material, it was not considered necessary to take out a patent for protecting the discovery. With the knowledge, therefore, that the final residues would be high, the following procedure was adopted. The partially-treated concentrate was partly dried by exposure to air, sieved to pass a twenty-mesh linear screen, and all lumps reduced to powder. Slaked lime, equal to 165 lbs. of actual CaO, was added by thorough mixing, and the mixture placed in a shallow vat. The small plant erected for the purpose consisted of:—

1. Treatment vat.
2. Zinc box.
3. Sump.
4. Pump, which could be also used for draining the pulp.

Water washes were given, the first drainings were alkaline, then turned green through presence of ferrous hydrate, next became clear but acid, and continued acid for forty-eight hours, when they again became alkaline. These were considered to be very curious phenomena, but a little thought given to the matter evolved a satisfactory explanation. In the first instance, an excess of lime dissolved and rendered the solution alkaline, this was followed by ferrous hydrate. The particles of the lime then became coated over with calcium sulphate, allowing the acid and ferrous sulphate to be washed out, finally the coating of the calcium sulphate was sufficiently dissolved to allow the excess of lime to dissolve, and the wash again became alkaline. Cyanide solution was then added, with intervals of draining, until eventually the mass became too closely packed to percolate. After draining as completely as possible, the whole of the contents of the vat were turned over and broken up, and the treatment re-commenced and continued until it was ascertained that no further gold could be dissolved either in the plant or by treatment of small samples in the laboratory. The residue was now washed free from cyanide, a sample taken and assayed, showing fifty-five per cent. extraction. The remainder of the sample was now treated with acid, washed thoroughly, and treated with cyanide solution (0.5 per cent.) and a little sodium peroxide, allowed to remain without agitation for three days, then thoroughly washed. The residue assayed one and a half dwts., proving once more that the difficulties experienced were due to an impervious coating consisting mainly of colloidal ferric hydrate. During the period occupied by this experiment, a good many cases came under the writer's observation where coarse sands from various cyanide residues gave very high results; for instance, some residues from the Mint Gold Mining Company gave four dwts. gold per ton insoluable in cyanide (three days' treatment), one from the Ginsberg seven dwts., similar treatment, and acid treatment prior to treatment with cyanide failed to give much better extraction. The idea then occurred to the writer that the gold might be "encased" or offered such small

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RAND MINING IN PICTURE



A Tube Mill Plant.

surfaces to the solvent that prolonged treatment was necessary. Experiments were then made with residue from the Robinson dump, sand passing a sixty-mesh (linear) sieve, assayed 0.25 dwt., the coarser sand remaining on a sixty-mesh (washed) assayed 3.2 dwts. On grinding the latter to pass a sixty-mesh sieve and agitating for thirty minutes with a 0.2 per cent. KCy solution, the gold contents were brought down to 0.25 dwt. and under. The same treatment was given to the Mint and the Ginsberg residues with similar results, the gold being readily dissolved from the fine material. Subsequent experiment on other material proved the general accuracy of the conclusion arrived at, viz., that the causes of low extraction were, either insufficient time allowed for the treatment by cyanide to dissolve the coarser particles of gold, or that the gold was encased. This led to the writer making further experiments with a view to accelerating the action of cyanide on concentrates. Speaking from memory, the writer came across an old patent of Siemens in which it was proposed to moisten the crushed ore with a solution of cyanide, expose the mixture in shallow trays to the air, then, when the gold had been dissolved, to leach out the alkaline gold cyanide in treatment vats. Using this as a basis, the writer treated 15 lbs. of fresh Robinson concentrates by damping with a five per cent. solution of cyanide and exposing these in three lots in very large porcelain "development" dishes. After twelve hours' exposure to the air with occasional turning over, the material was placed in a leaching jar and leached with water for about three days, until no gold could be detected in the filtrate. The final residue assayed under 1.5 dwts., giving an extraction of over ninety-eight per cent. This was the origin of "double treatment." In July, 1894, the writer left the Robinson to commence private practice, at the same time acting as consulting metallurgist to the Barnato group of mines. The cyanide works of the New Primrose Gold Mining Company were then in an almost hopeless condition, the cost of running the plant for June, 1894, being, it is said, £110 more than the gold recovered; ten tons of what was alleged to be gold slimes from the extractor boxes having to be smelted in plumbago crucibles. Without going into full details, which would fill a volume, it may be said that the old portion of the plant was the most badly designed works, for its size, in existence. It was a nightmare. One treatment vat containing a slimy charge had been standing for seventeen days, and its first solution was still above the surface of the charge. Filters were clogged or partly torn so that sand and slime came through with the solution. All the vats leaked and none of the plug (solution) cocks were watertight. The vats were placed in an excavation so that all solutions had to be pumped from them into extractor boxes, some of which were half full of sand and slime, the storage tanks were placed over the treatment vats, the supports for which formed a perfect forest of beams and battens. The extractor boxes and the clean-up plant were placed on a floor to one side of the storage tanks and above the leaching vats. Three-inch pipes, with branches, supplied the vats, thirty in number, with solution, and an enormous amount of time was wasted in getting the necessary solutions on to the charges. The pumps were leaky, being scored by the sands drawn over with the solution. The writer placed all these faults and defects before Mr. J. Hays Hammond, the consulting engineer, who gave the writer a free hand to effect what alterations and additions he considered necessary, and the work of regeneration was started. Advantage was taken of the dry season to dry and screen the slimy sands and mix them in suitable proportion with clean sand. The system of sampling was altered. Previously wooden boxes (candle or dynamite) were used to retain the "grab" or "rod" samples of residues; paraffin tins were then substituted, the results proving that samples previously taken gave too low results by about ½ dwt. gold per ton. The unaccountable discrepancy which had previously existed between assay results and actual returns began to disappear. It has been stated that the gold not accounted for was lost by volatilisation and dusting, but the writer proved by actual sampling and assaying and superintending a few "clean-ups" that the contention was absurd. The writer had also been informed by the police that certain persons in the vicinity of the mine were strongly suspected of being receivers of stolen gold, and this led him to take certain precautions to avoid loss of gold by theft. After a new

TIN MINING IN THE TRANSVAAL



South African Tin Co.'s Mill at Doornhoek

extractor house, properly equipped with filtering arrangements and filter press clean-up outfit, had been erected, introducing an entirely new system of pipe lines and watertight valves, solution tanks outside the extractor house connected and coupled so that solution could be supplied to the treatment vats in one-tenth the time previously taken, all the pumps overhauled so as to give a five-pound vacuum if necessary, all the treatment vats caulked where examination had revealed defects, new filter cloths put in to replace those worn or useless, cocoanut matting dried and beaten to remove sand and slime, or replaced if badly damaged; a vacuum filter pump installed to facilitate drainage from collecting vats (Butters' and Mein's system), circular baffle boards put into each collecting vat, which saved an extra five per cent. of sands, and everything was working smoothly, it was decided by the directors that no extra vats, other than a few old ones in stock, would be provided to treat the extra pulp produced by the additional sixty stamps, which were to drop on January 1st, 1895, the writer's recommendation for additional vats being ignored, it being considered that the plant had ample capacity to treat the sand from one hundred and sixty head of stamps. After the new stamps had been running a week or so, the manager, Mr. G. W. Starr, informed the writer that the theoretical extraction had dropped fifteen per cent., and strongly urged him to try and devise some means whereby the normal extraction could be regained. Naturally, more treatment vats was suggested, or a second treatment in vats placed on the dump, as a sort of makeshift, but it was pointed out that the directors had definitely made up their minds to incur no further expenditure on plant.

Double Treatment.

As a result, the experiments previously referred to (made at the Robinson mine) were thought of, and a trial of what is now known as "double treatment" was made. This was successful beyond the most optimistic expectations, and a free hand was given to the writer to convert the collecting vats into preliminary treatment vats and to carry out his system for the whole works. All wooden collecting vats were caulked with hemp, Stockholm tar, and cement, and as each tank was got ready it was put into commission; suitable devices were arranged to prevent loss of cyanide solutions. So long as the sands, when drained by the vacuum pump, did not retain more than seven per cent. moisture the method acted perfectly, with wet or slimy sands the extraction was poor. It was soon found that a better supply of water to the distributors, and filling the collecting vats with water before filling with sand, effected the necessary removal of slimes, and no hitch was afterwards experienced. With a two and a half days' actual treatment under the new system, an actual recovery nine per cent. higher was effected than when one hundred stamps were running, and three days' actual treatment was given. The month before the writer was appointed consulting metallurgist, the loss, as before stated, was about £110. Nine months afterwards the monthly profit was in the neighbourhood of £10,000. The manager, Mr. George Washington Starr, duly received the credit for the successful work. He was appointed consulting engineer for the group in place of Mr. John Hays Hammond, who resigned, with salaries which, it was stated, reached the aggregate of £11,000 per annum. The Consolidated Gold Fields people asked the managing director of the New Primrose what he thought of the writer's work. His answer was: "Bettel is a good man, but expensive"! Encouraging? I don't think. "Double treatment" thus successfully introduced at the New Primrose, was readily adopted elsewhere without acknowledgment, especially at the Crown Reef, where it was the means of effecting a reasonably decent extraction not hitherto possible with direct filling and short treatment.

It is necessary to explain that double treatment is not absolutely essential for securing high extractions. Long continued treatment, even for rock crushed through a nine hundred-screen, will, as Mr. E. H. Johnson proved at the Princess Gold Mining Company in 1895, the writer believes, when this well-known metallurgist obtained upwards of a seventy-seven per cent. extraction from material which gave about a sixty-seven per cent. extraction in the (then) usual short treatment. Long continued treatment is usual at the present day.

Steel Tanks (Storage and Treatment).

In 1895, Mr. Speke, then assayer and late cyanide manager of the Geldenhuis Deep, with the assistance of the engineering staff of the Rand Mines, designed and erected steel tanks (superimposed) for direct filling and cyanide treatment, large tailings wheels being employed to elevate the pulp to the necessary height demanded by the direct filling process. (The latter process, it may be said, does not readily lend itself to "double treatment.") The East Rand Proprietary Mines also adopted steel tanks with a modification of the "garden sprinkler" distribution of pulp, which was, however, not very effective, a large amount of fine sand escaping with the slime (as the writer knew, later, to his cost). This modification was adopted to avoid paying royalty for the use of Butters' and Mein's distributor. As the latter process would have collected a further seven to ten per cent. of sands for cyanide treatment, and left the slimes fairly sand-free, the wisdom of the decision is hardly apparent to an onlooker.

Space must now be given to the Siemens-Halske process introduced by the Rand Central Ore Reduction Company and installed by Messrs. Siemens and Halske's expert metallurgist, Mr. A. von Gernet, whose services were transferred for that purpose to the above-mentioned company. In the proceedings of the Chemical and Metallurgical Society of South Africa, vol. I., pp. 15-17 and 28-33, will be found descriptions of a plant erected at the Worcester gold mine by the Rand Central Company, where very dilute cyanide solutions were used for dissolving the gold, the plant having such capacity that nearly five days' treatment could be given to a charge of tailing (five tanks, one charge per day). The weak gold-bearing cyanide solutions were passed through the Siemens-Halske electrical precipitation boxes, the gold and silver precipitated on strips of lead foil which were the cathodes, plates of sheet-iron covered with sacking, sewn on, being the anodes. Prussian blue, ferric hydrate, etc., precipitated on the anodes, gradually fell to the bottom of the deep boxes, and the mud was periodically removed, dried, and treated for the recovery of its gold contents. A method



A Typical Rhodesian Prospector's Camp.

proposed, but not carried out in practice, for recovery of the cyanogen contents of the by-product was proposed by Von Gernet. After suitable intervals, the lead strips were removed, made up into balls, and smelted in a pan furnace, the gold-lead cupelled, and the cupelled gold remelted in plumbago crucibles. The battle of the processes then commenced. Mr. J. R. Williams and his colleagues were the champions of the zinc-precipitation process, and Messrs. Butters, Von Gernet, Durant, Caldecott, and others defended the electrical precipitation process. The objection of the technical representatives of the mining houses seemed to be that the electrical process required too much skilled supervision and was more expensive in working—in other words, Kaffirs could not run the plant without skilled supervision, and a royalty of one and a half per cent. on gold won had to be paid to the owners of the Transvaal patent. The zinc people eventually won, for the electrical process is practically extinct on these fields.

Dry Crushing.

Certain friable ore from the George and May Mine yielded fairly good results for some time by coarse dry crushing, followed by cyanide treatment. This led several people to jump to the conclusion that such a process was universally applicable, and wild hopes were raised that the low-grade reefs on the Rand and elsewhere could be treated by the dry crushing process. Subsequent experiments have, however, conclusively proved that there is no hope in this direction for treatment of ordinary low-grade banket ores.

Direct Crushing with Cyanide Solution.

In 1892, experiments were made at the May Consolidated by crushing ore with cyanide solution, but as no provision was made for removal of slime, the experiment proved abortive, effective aeration and leaching being impossible. Subsequent experiments at the New Goch (1906), made by Mr. H. S. Denny, were more successful, but the method was discarded in favour of the old process.

Tube Milling and Filter Pressing.

Mr. Denny also introduced tube milling of concentrates and coarse sands and filter pressing of cyanide-treated pulp at the New Goch, and recommended an "'all-sliming" treatment of gold ore followed by filter pressing. The writer, being the first introducer of filter presses for gold-slime clean-up and experimental treatment of battery slimes, may be allowed to express an opinion regarding filter pressing in connection with the cyanide process. As a dewaterer, the apparatus, compared with various vacuum filters, is cumbersome and expensive, but effective; fine sands may, moreover, be present with advantage in the slime pulp to a considerable extent. In the majority of vacuum filters—the Ridgeway excepted—sand must be removed before filtration for effective working. For washing out the soluble gold it has been proved in West Australia, by actual work done during the past five years, that the filter press is far inferior to the vacuum filter, especially the Ridgeway basket filter, which, it is stated, has successfully treated large amounts of filter-press residues containing six to eight grains of dissolved gold per ton at a cost of fourpence per ton of residues treated. Each unit has a capacity of five hundred tons a day of sandy slimes residues.

Space forbids more than a passing mention of the numerous improvements and introductions in the "hydro" and "dry" metallurgy of gold by Mr. Charles Butters and his staff, the Consolidated Gold Fields staff, and others, which are fully described in a recent publication* and in the "Proceedings of the Chemical, Metallurgical, and Mining Society of South Africa," to which readers are referred. The battle of gold extraction processes is nearly over. Engineers and metallurgists have done much, and are still engaged in doing more, to effect economies. The work of the research chemist on these fields is almost completed, at any rate so far as the routine cyanide process for extraction of gold is concerned.

*Rand Metallurgical Practice. Vol. 1. Griffin & Co., 1912.



Consolidated Gold Fields Offices, Simmonds Street, Johannesburg.



Development of Diamond Recovery Methods

in German South-West Africa

Prize Paper by DR. JOH. E. BARNITZKE

WHEN in May, 1908, diamonds were first discovered in the sand dunes about ten miles east of Luederitz Bay, there was no one on the spot who had any experience in the winning of the precious stones. Recovery operations were in the beginning, therefore, carried out only in the most primitive way by Ovambos and Cape boys crawling along the ground and picking the stones by hand. Some places proved of such richness that the boys often delivered as many as forty stones, in some cases even a hundred stones. This method naturally proved by no means a perfect one, and it was replaced by more efficient methods as soon as these could be introduced; only at outside places which suffered from lack of transport was it continued for a longer time. At other spots sieving and washing were started. Fairly satisfactory results were obtained by hand sieving and washing as long as surface deposits only were treated, consisting mainly of gravel from which the fine sand and clayey portions had been removed by the wind, thus showing diamonds more highly concentrated. The concentrates ("deposit") vary in composition, but mostly consist of garnets, olivine, iron pyrites, limonite, hæmatite, magnetite, particles of country rock, and diamonds; these minerals form the so-called "heart" at the bottom of the sieve, while the rest is principally composed of white quartz and chalcedony or variegated agate. By turning the sieve upside down, the heart is exposed and the diamonds can be picked out.

It soon became apparent that this method was lacking efficiency for various reasons. As the specific gravity of the diamond, being 3.5, holds an intermediary position between those of quartz (2.6), olivine (3.0), and some of the above-mentioned minerals, as garnet (4.0), pyrite (5.0), and hæmatite (5.2), while it does not vary to any great extent from others, as limonite (3.4 to 4.0), not all the diamonds would settle at the bottom of the sieve, which meant only a partial recovery, not considering the loss of diamonds occasioned in the ordinary way by oversight owing to the large quantities of gravel treated.

This method lost favour when more gravel from the underlying beds was handled, in which, apart from yielding less diamonds, fine sand and clay occurred in larger proportions thus rendering sieving and washing less effective. At this stage the output per boy on a certain good field amounted only to .5 to 1.3 carat in fine weather and to .26 to .75 carat on rainy days.

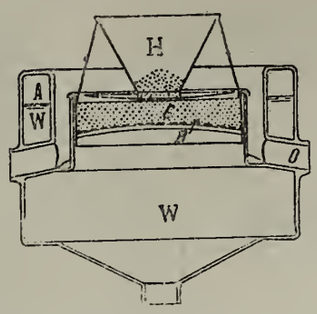
It was, therefore, found necessary to improve both the preparatory and washing processes. In this respect the material was now first dried before sieving, lest the clay should choke the meshes, and shaking screens were introduced, called "babies." It is true that no good classification of the material was obtained, which, after the clearing of the fine sand and boulders varied in size from one-sixteenth to three-eighths of an inch, but the quantity handled was quite satisfactory, amounting to as much as eight cubic yards per two boys' shift.

A further improvement could be recorded from revolving screens ("trommels") consisting of a conical screen of different gauges revolving round a slightly inclined shaft and being operated by one or two boys. By means of cams and dropping weights, promoting jerks, the meshes were supposed to be kept clear of the fine sand and the clay. But a drawback of this machine is the comparatively large wear and tear of the fine screen, which covers the major portion of the drum, by the bulk of the stuff passing over it, thus also choking the meshes; yet with proper attention good results were obtained. On the other hand, the gravel, say from one-sixteenth to three-eighths of an inch in grain, is classified in four or five sizes, therefore securing a much better jigging than with unclassified material. For a similar purpose a classifier of the shaking screen type was recently designed and constructed by Messrs. Schuller and Kellner.

In order to reduce the inevitable irregularities attendant on manual labour, and at the same time to attain the treatment of a larger quantity of stuff by continuous work, various types of washing machines, as installed on British South African fields were tried, amongst others rotary pans and hand-driven jigging machines, called "Johannesburg" and "Capetown" (Caspareuthus) type. The former gave no satisfaction, and were soon discarded, while jigging machines were universally adopted. Their action is based on the percussion jigger principle. At first ten to twelve cubic yards of gravel were passed through these machines; but it was found out that only half of that quantity could be properly treated. Owing to the irregular working of the machine, a large loss of diamonds resulted, amounting to as much as forty per cent., the same percentage as with handwashing. Local imitations of this machine, although announced as improvements, showed no better results.

In the meantime, the principal companies operating on the fields used every effort to devise more effective means to deal with the diamondiferous sands, in which connection a scientific staff was kept on the fields; also quantities of material were shipped for making experiments at Home. The first success was obtained by Mr. Max Schiechel, consulting engineer to the Metallurgische Gesellschaft, Frankfurt a/M." A brief description of his invention, called the "Pneumatic Schiechel

Separator," may be given in the following, illustrated by a sketch.



SCHIECHEL SEPARATOR, (Cross section), Sc. 1: 16.4.

The principal part of this contrivance consists of a cast-iron pot, whose outer wall is turned inside so as to form partially an inner wall, to which a circular screen (B) (one-sixteenth inch mesh), fifteen to eighteen inches in diameter, is fixed. Two inlets, one for water (W) and one for compressed air (A), are fitted at the upper part of the pot, while outlets for the overflow (O) are provided for at the lower part.

When in operation, the pot is partly filled with water and the screen is charged with a layer of two to three inches of gravel (G). By means of compressed air, the water is kept in constant motion and is intermittently forced through the screen, thereby performing the jigging and discharging the lighter material as overflow. After setting, the water can be returned again.

The diamonds are recovered once or twice a day from the concentrates, which remain at the bottom of the screen; as they represent only a small quantity, they can be easily examined on sorting tables and the diamonds picked out. This system has also the advantage of greatly reducing the possibility of theft of stones.

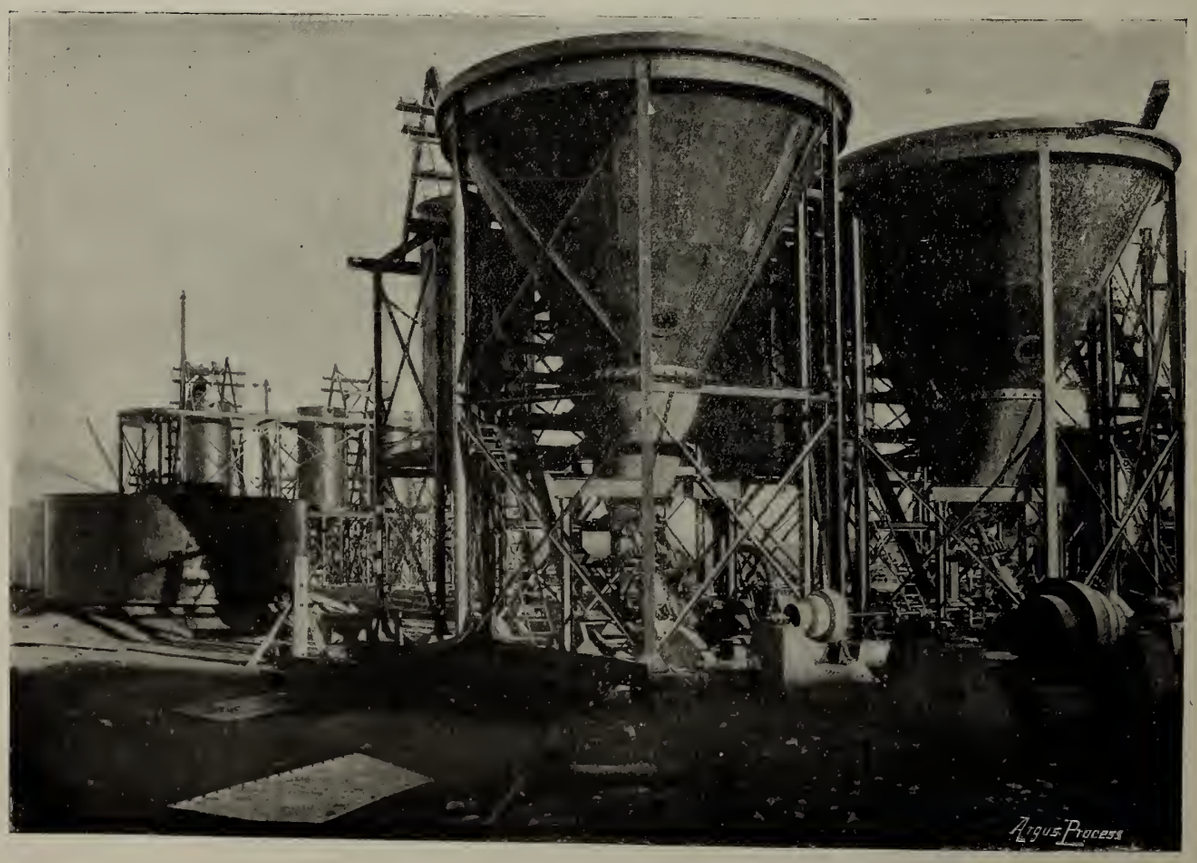
The first plant of this type, consisting of six separators, was erected at Bogenfels in May, 1910, and the success of this plant was followed by the ordering of eight larger plants within a year.

The capacity of a plant of twelve Schiechel separators is about fifty cubic yards of classified gravel per twenty-four hours, the product of from four to sixteen times the amount of original sand. Thirty-five to forty natives are required for the operation of the plant, and one hundred and fifty to two hundred and fifty for shovelling, sieving, and transporting.

The loss in diamonds, especially of small-sized stones, may be estimated at 5 per cent. It is true that certain tests showed a higher figure than the one mentioned, but this can be ascribed only to the incompetency of the operators. Since then the machines have been further improved. The hopper (H) directly above the screen has now been fitted round the mouth with a large spherical flange, as shown in the cross-section. This allows the gravel to spread more evenly, prevents overflow before jigging has taken place, and at the same time necessitates the water to flow in an outward direction, carrying with it a greater discharge of the lighter gravel of the upper portions of the bed. The screen is now made of convex form, the heavy minerals, including diamonds, gravitating to the outer edge of same. The above improvements are said to add greatly to the efficiency of the jigging, increasing the quantity of gravel treated and minimising the loss of diamonds.

Besides the Deutsche Diamanten Gesellschaft, other companies have adopted this system, amongst others the Colmanskop, Ltd., Weiss-De Meillon, Swakopmunder D.G., Carlstal D.G., etc.

A great advantage of the Schiechel separator, especially for the conditions in German South-West Africa, is the simplicity of its construction, showing no bearings or other movable parts exposed to dust and sand storms. Notwithstanding the fact that the Schiechel separator was a marked success, the Koloniale Bergbau-Gesellschaft, the largest diamond company in



Arbuckle Cones.

German South-West Africa, who also work the fields of the Government Pacht Gesellschaft, continued experiments of their own to find out a system applicable to operation on an extensive scale by a central plant. As the result of these experiments, which were conducted on scientific lines and with great care, the company decided to adopt a combination of washing trommels, flat shaking screens for wet sieving, and a new piston jigger, constructed by the Humboldt works, Cologne.

The results obtained were by far superior to those of other systems, and it may, therefore, be interesting to learn some figures, established by these experiments, namely :—

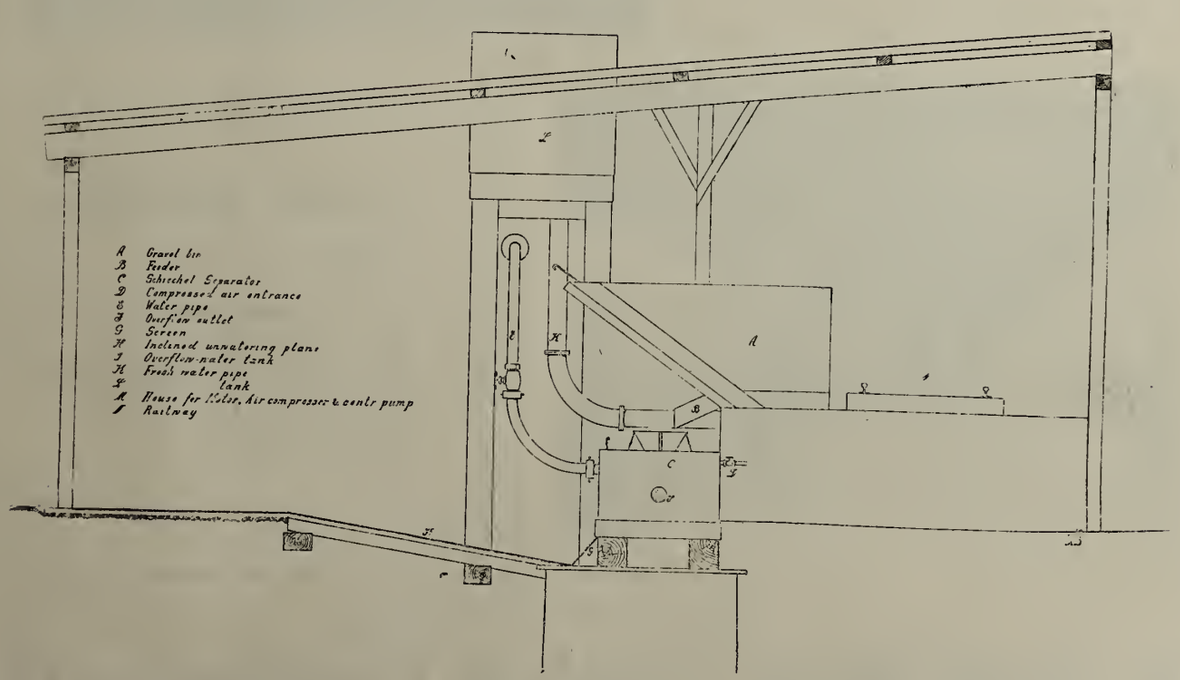
Size of gravel in inches...	1/25—1/12	1/12—¼
Number of Tests	8	3
Quantity treated in cubic feet	413	292
Working hours	61½	30
Average quantity per working hour, cub. ft....	7.75	9.72
Maximum ,, ,, ,, ,,	8.10	10.80
DIAMONDS FOUND—		
1st washing, number	223	449
,, weight in carats	19.50	81.85
2nd (control) washing, number	6	7
,, weight in carats ...	.60	1.25
LOSSES IN PER CENT. OF THE TOTAL AMOUNT OF DIAMONDS—		
Average number	2.50%	1.5%
Average weight	3.0%	1.5%
Maximum weight	9.1%	2.03%

Recent improvements enable the Humboldt works to guarantee the loss of diamonds not to exceed 2 per cent., at the same time guaranteeing an increase of the quantity of gravel to be treated to the extent of 40 per cent. If this actually works out in practice, the results must be regarded as exceedingly satisfactory.

Tests were also made with heavy liquids, grease tables, etc., but these methods did not prove suitable for the winning of German South-West African diamonds. For remote fields an easily transportable plant has been designed by Messrs. Schuller and Kellner and constructed by Krupp-Gruson Works. It may be described as a percussion jigger with slow upward and quick downward movement of the screen, cleverly adapted to local conditions. This machine has been tried on a field of the Deutsche Diamanten Gesellschaft. According to the statements of Mr. Kellner, a double set of the machine dealt with eight cubic yards of classified gravel in five hours, the loss of water being three-quarters to one cubic yard, but actual working results are not to hand.

For the Vereinigte Diamantminen, Luederitzbucht, the firm of Messrs. Amy, Giesecke and Konegen is erecting a central plant with plunger-jig machines. The principal new feature is the adoption of a sieving method hitherto used in corn milling only, by which a conveyor moving on the screens is supposed to accelerate the sieving process and to keep the meshes clean.

With regard to the further development of diamond-winning methods, it is doubtful whether any marked headway will be made in the near future owing to the deplorable economic stagnation at present prevailing in German South-West Africa. But, in all probability, the Schiechel and Humboldt machines, which have attained such a high standard of efficiency, will also hold a first rank amongst diamond recovery machines in future. It may be only a matter of time that these machines will be introduced with great advantage also in British South Africa, especially on alluvial fields, where nothing seems to be known yet of the great achievements of their neighbours in this line.



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The Manufacture of Steel in South Africa from Scrap

Review of the Trade in Scrap :: Sources and Value of the Material Possibilities of the New Industry.

By G. HALFORD SMITH

THE question has often been asked through the Press and otherwise, "Why does the Government allow our immense accumulation of scrap iron and steel to be exported to Europe whilst the articles manufactured from the same scrap are imported from Europe at a high price? Why cannot the manufactured articles be made in the country?" This article is the result of some years' experience in the purchase and export of scrap to Europe on a large scale, and my remarks may be of interest in view of the probability of steel works being established in South Africa in the near future.

Scrap Shipped.

Until within the last twelve years or so mine managers and engineers were in the habit of getting rid of the scrap which seriously hampered their operations by throwing it down old winzes and shafts or transporting it to sites on which it was intended to deposit tailings and other "refuse." However, as the accumulations became large, dealers began to purchase this scrap and ship it to Europe, and the railways fixed a low rate for railage to the coast to facilitate its removal. Many thousands of tons of scrap have been collected on the Rand since the war and shipped abroad —principally to Italy—where it has been largely used in connection with the construction of men-of-war and Italy's mercantile marine. Italy is a maritime country and has a powerful navy and a large mercantile fleet. She builds most of her vessels in the country, but she has practically no ironstone, and has consequently to depend for her raw material on scrap imported from abroad.

It has generally been assumed that vessels come to South Africa fully laden and have to either return empty and pay for ballast or take up cargoes at merely nominal freights. This is quite an erroneous notion. The rates from South Africa to Italy vary from fifteen shillings to twenty-five shillings per ton, and it is difficult to obtain freight even at these prices. After allowing for cost of collecting the scrap and loading it on to trucks, railage to the coast, handling at the coast, freight, insurance, agency, and miscellaneous expenses, the margin of profit is small; in fact, I understand that several large dealers have lost heavily during the last few years. Further, the fluctuation in the market value in Europe (which has varied as much as £1 per ton during the past few years), the risk of shipwreck, which means—as I know to my cost—the locking up of thousands of pounds of capital for many months until the insurance company pays out, and other risks have to be borne in mind. Still, although the risks are considerable, a fair return on money invested and time spent has been earned by those who have exercised care and prudence in the business, and who have had ample capital to tide over untoward circumstances.

Local Uses of Mine Scrap.

During the past few years, when "working costs" have loomed so large on our local horizon, the managers and engineers of our mines have used much of the scrap on their properties for different purposes. For instance, old shoes and dies which used to form a large proportion of the scrap exported are now used for flooring workshops and other places where there is considerable traffic, also for lining ore bins; the ends of drills and jumpers are used for lining tube mills; old piping is used for fencing purposes; and, in fact, a considerable quantity of scrap that used to be available for export is not now available. From a careful estimate I made some time ago, I think that the wrought iron and steel scrap output of the mines of the Rand—apart from demolished batteries and machinery—does not amount to more than about two thousand tons per annum. The old accumulations that one used to rely on are nearly all cleared away, and managers, being relieved from the inconvenience of the presence of immense scrap heaps, and competition being keen between buyers, are able to get prices quite one hundred per cent. higher than they got ten years ago.

Railway Scrap.

The above remarks apply to scrap from the mines of the Rand; they do not apply to the railway scrap, which forms the large bulk of the scrap output of South Africa. As the safety of life and limb on the railways depends largely on the use of the very best material for all purposes, as soon as any parts become worn they are discarded and replaced by new parts; whenever some improved apparatus is adopted, everything connected with the older apparatus has to be at once scrapped throughout the Union in order to avoid possible accidents through the using of old parts that do not fit in with the new apparatus; in fact, I have myself shipped many hundreds of unopened cases containing material that has not been used, but which has been scrapped for this reason. The output of scrap from the Union Railways will, I think, run into quite ten

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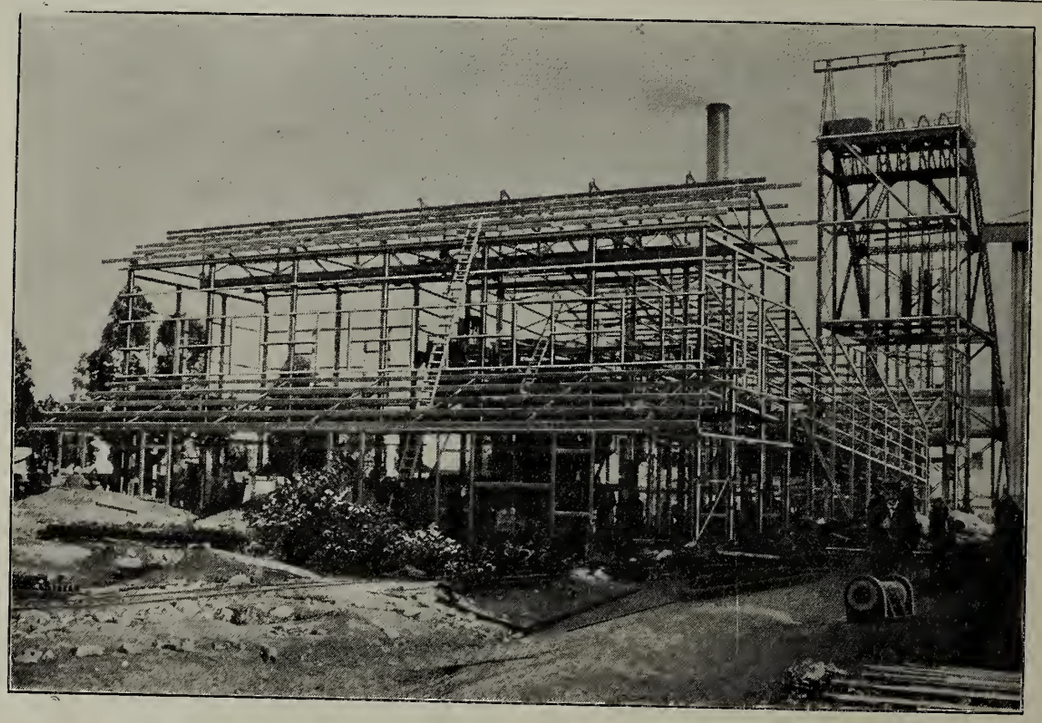
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thousand or more tons per annum, so that the total available scrap from the gold mines and railways, apart from demolished machinery, etc., will not amount to more than from twelve to fifteen thousand tons per annum. There are, of course, further sources from which scrap is obtained, viz., diamond mines, blacksmiths' and engineers' shops, etc., but the output from these is small.

History of the Present Enterprise.

Early in 1910 the late Transvaal Government called for offers for the erection of steel works in the country, and as an inducement undertook to so adjust railway rates or to impose an export duty on scrap as to make it unpayable to any longer export scrap iron and steel. They did, as a matter of fact, raise the railage on scrap for export from a halfpenny per ton per mile to one penny per ton per mile, which has had the effect of entirely stopping the export except from coastal districts. A considerable quantity of railway scrap is, however, still being exported from districts near the coast, and the Railway Department has been forced to send thousands of tons of scrap from the interior to the coast and sell it there to relieve the congested state into which the stacking grounds were getting. The offer of one of the tenderers was accepted by the Union Government some months ago, but the tenderer failed to carry out his obligations, and a similar agreement has been entered into by Government with another tenderer, who, having been successful in raising the necessary capital, is now erecting works at Vereeniging.

The instalment of large steel works in South Africa, especially in the neighbourhood of the Rand, which is the principal market of the sub-continent, would afford employment to many workers and would benefit the country in many ways; on the other hand, the railways would lose the railage on scrap sent to the coast for export and on the finished articles imported from abroad. The Government has in view, however, the manufacture of iron and steel from the ores of the country, and if such an industry could be established, the benefit to the community generally can scarcely be over-estimated. In the agreement with the promoters of the steel company above referred to, the Government has bound the company to perform certain experiments with this object in view within a specified time. The difficulty to be surmounted consists, I understand, in the presence of refractory ingredients in the ores themselves, which up to the present science has not been able to overcome, but this difficulty will doubtless disappear as further research is made; in fact, I am informed that with the use of cheap electric power the difficulty has actually been overcome in other countries already. The site for the steel works is at Vereeniging, where a powerful electric plant is in course of erection by the Victoria Falls Company, so that there should be no difficulty in obtaining ample electric power at a reasonable cost.

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Safety Catches for Mine Cages

By J. A. VAUGHAN, M.I.C.E, M.I.M.E.
(Chief Inspector of Machinery, Mines Department, Union of South Africa)

INITIALLY it was not the intention of the writer to do more than resurrect some of the truths which have in the past been established by Commissions of Enquiry with respect to safety catches, and which have since then lain buried in blue-books; but, so as not to limit this to too brief a communication, he has also decided to supplement the statement of established facts with a collection of the more important opinions expressed by these commissions, or by the witnesses who appeared before them, together with such criticism as appears necessary.

Starting off with the most recent pronouncement, it is to be noticed that in the second report of the Royal Commission on Mines, Great Britain, published in the year 1909, on page 160, is to be found the following:—

"Safety Catches or Clutches.—In view of the opinion expressed by a large number of witnesses before us, and the observations of the Committee, we are unable to recommend that the use of safety catches or clutches should be required by law."

For the purpose of after reference, this pronouncement will be called Decision "D."

In the year 1907, the Transvaal Rope and Safety Catch Commission reported as follows: "Seeing that the possibilities of a satisfactory safety catch for vertical shafts have been established, the Commission recommends that the present regulation shall remain in force, and that the question of the applicability of any particular safety catch should be left to the Government Mining Engineer to decide. The Commission, while not wholly satisfied that any of the safety catches tried entirely meet the requirements of such an appliance, consider that, of the designs submitted, the following give the best results: For vertical shafts with wooden guides, the 'Undeutsch'; for vertical shafts with wooden guides, the 'Schweder'; for vertical shafts with steel guides, the 'Schweder'; for inclined shafts with steel rails, none at present, but advise early trials of suitable designs."

Let this be called Decision "C."

The Commission of the Mining District of Dortmund, Germany, of 1902, published the following opinions: "According to the above [evidence] then, safety catches have in many cases been of great use; whilst, on the other hand, no proof has yet been given of any person having sustained serious injury through their use. This consideration should influence the retention of safety catches. To enable them, however, to fulfil their object, care should be taken that they are constantly kept in irreproachable condition, whilst the springs should be frequently and periodically renewed. Furthermore, the guides should be of sufficient strength and section, and be constantly inspected. To prevent the frequent occurrence of untimely action of the catches when winding ore, and thus to preserve both guides and catches, the Commission recommends that when hoisting ore or materials the safety catch should be put out of gear. As it would, however, be impossible to effect this with many kinds of catches without a serious amount of alteration, the Commission are of opinion that such putting out of gear should not be made compulsory."

Let this be called Decision "B."

The designation Decision "A" is reserved for that of the Royal Commission of Accidents in Mines (1879-1886), Great Britain, which stated: "Although circumstances may sometimes favour the action of safety catches, it is evident that serious danger will still remain from the possible rupture of the guides, in consequence of the strain put upon them by the sudden checking of heavy weights (which may often amount to ten tons) when moving with velocities of thirty to sixty feet per second. In the earlier years of these inventions much confidence was placed in their certainty of action, but we have ourselves observed that several varieties, after being tried for a few years, have been discarded, whilst with regard to others which survive, opinions are much divided as to whether they do not introduce fresh sources of danger. There are, in fact, many cases on record of clutches coming into operation when not required. On the other hand, experience has unfortunately shown that many examples of safety appliances have, at the critical moment, failed to act, some even when provided with a brake lever under control of a practised man, in addition to an automatic arrangement. Such appliances will, of course, have the best chance of acting successfully with the ascending rope, and in cases where the speed is moderate, and the conductors are solidly made of wood or of iron or steel rails, we hope that some of them may yet be found available. We have, however, examined several varieties of the safety catches in use, as well as those exhibited at successive international exhibitions, and we have considered a large number recently described and figured in an elaborate paper by Herr Sulbach, and we are unable to come to the conclusion that any one of them is a trustworthy safeguard against accidents."

Commenting on Decision "A," theCommittee that advised the Commission responsible for Decision "D" state: "Over twenty years have elapsed since that report was written, but we regret to say that the hopes expressed by the Commission have not been fulfilled. There are a few such appliances, which can be used with rigid wooden or steel guides, and which are fairly effective under certain conditions, but none of them, in our experience, are absolutely reliable. We are not aware of any satisfactory safety catch which can be

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used with wire rope guides, and, as we mention in our report, this type of guide is largely used in this country."

From the terms of this comment, one important reason for the dissimilarity in these four decisions is disclosed. The kind of guide used in the shaft is evidently a matter of great importance, and will be alluded to later. It may be mentioned here, however, that in the mines of the United States of America and the Continent, where wooden guides are in general use, the use of safety catches is general, and in many cases compulsory. In the Transvaal, safety catches are prescribed by the regulations "where applicable," and this applicability has up to the present time been taken to hold in the case of a vertical shaft with wooden guides. It is interesting to note, while here dealing with safety appliances connected with winding in shafts, and without quoting the exact opinions expressed by the four Commissions, that opinion has veered round in favour of the compulsory use of appliances to prevent "overwinding," and the 1909 report of the Royal Commission of Great Britain contains the following recommendation: "The use of detaching hooks should be made compulsory in every case. Many witnesses consider the use of automatic controlling devices to prevent overwinding desirable. A description of the better known of these devices will be found in the report of the Committee. We are of opinion that their use should be made compulsory."

With respect to the use of safety catches, as stated above, the Decision "D" was based upon the opinion expressed by a large number of witnesses and the observation of the Committee. An analysis of the evidence given by the witnesses shows that the colliery owners, consulting engineers, and the mine managers were generally against the compulsory fitting of safety catches or clutches, while the miners' representatives favoured the use of these appliances.

The Committee referred to, which was appointed as an advisory body by the Royal Commission on Mines, consisted of Messrs. R. A. S. Redmayne (Chief Inspector of Mines, Great Britain), A. M. Lamb, and W. Walker. The report of these gentlemen to the Royal Commission, 1909, contained the following remarks: "In 1905, the Transvaal Government appointed a Commission to enquire into, among other matters, the use of safety catches, and this Commission made a number of practical tests with several types. Eighty-four designs were submitted to them, but only five were selected for trial. The results of these tests are given in the report of the Commission issued in 1907, in which they state that they were not wholly satisfied that any of the safety catches tried entirely meet the requirements of such an appliance, but they consider that the best results were given by the Undeutsch and Schweder devices for wooden guides and the Schweder also for steel rail guides. They recommended that the Government regulation, that safety catches should be used where applicable, should remain in force and the Mines Department should prescribe what safety catches should be used. We observe, however, that the safety catches which were tested were subjected only to a maximum load of three tons and a speed of one thousand two hundred feet per minute, and both these conditions are very much below those in daily use at the great majority of mines in this country. At a well-known Yorkshire colliery, for instance, the weight of the cage loaded with full tubs exceeds twelve tons, and the speed at mid-shaft is three thousand eight hundred and eighty-seven feet per minute. It can readily be imagined how

great would be the strain put upon the conductors by the safety catches suddenly coming into action—whether by the breaking of the rope or by an irregularity in the working of the apparatus—and it seems to us that whether rigid or wire rope guides were in use, they would inevitably be broken or deranged, and any persons in the cage would be killed.

"The high degree of safety reached in the matter of travelling in the shaft of a modern colliery has been frequently commented on, and we think that the statement of the Royal Commission on Accidents in Mines, that there is perhaps in the whole range of engineering nothing more remarkable than the small number of accidents which attends the lowering and raising of men, is equally true to-day, in spite of the large increase in output and the number of persons employed. The number of fatal accidents in this country during the decade ending December 31st last, caused by broken ropes and chains in shafts, at mines under the Coal Mines Regulation Acts, when the enormous number of winds is taken into consideration, is very small. During the period thirteen accidents, causing thirty-two deaths, have occurred under this head. Of these accidents, five, which fatally injured eight persons, would not have been prevented by the use of safety catches, even if they could have been applied and they acted successfully. It must also be remembered that a certain number of accidents might have resulted by the catches coming into action when they were not required. On the other hand, some of the accidents might have been obviated if other precautions, such as the periodical re-capping of winding ropes, had been observed.

"In our opinion, it is much better to rely on good material in the ropes, chains, and other tackle; careful periodical examination and re-capping, annealing, etc., during their working life, to fix a maximum period for the life of a rope, and to allow a liberal margin between the working load and the breaking strain of the winding tackle, than to employ safeguards which, under the conditions obtaining in this country, can only be considered of doubtful value.

"We do not wish by the above remarks to discourage in any way further developments in the invention of reliable safety catches. It is obvious that, in view of the increasing number of persons who are allowed to ride in one cage, any accident from the breaking of a rope—rare as it may be—would be attended with disastrous results. For this reason, if we were aware of any safety catch which was absolutely reliable, we should feel little hesitation in recommending its adoption. While we are satisfied that there is no such invention at present, it would be rash for us to suggest that the problem is incapable of solution. We think it might tend to stimulate invention, and at the same time disclose defects in existing apparatus, if facilities were offered for putting these appliances to practical test in a colliery shaft, and we commend this suggestion to the consideration of the Institution of Mining Engineers."

With reference to the Committee's criticism of the method of practical test applied by the Transvaal Committee to the safety catches selected for trial, it has to be remarked that the conditions existing at the Marcus shaft of the Langlaagte Estate and Gold Mining Company, Ltd., where by kind permission of the directors the trials were carried out, did not allow of any more severe test. The wooden guides were four inches by four inches, and old. As will be pointed out later, however, in dealing with the calculations of Professor Undeutsch, the "catching force" of the safety device should be (and is capable of being made) independent of the descending velocity of the cage when the safety catch is called into action, while any greater weight of the conveyance and its contents can be reckoned with by increasing the depth of penetration of the prongs of the catch. It need hardly be stated that, when dealing with these heavier weights, the strength, and therefore the weight of the safety catch apparatus, would have to be augmented.

This is a matter, however, of engineering design that has not to be guessed at, but is capable of proper and exact treatment, the maximum forces and reactions called into play being calculable for any assumed conditions.

With reference to Decision "C," the writer, who was a member of the Transvaal Rope and Safety Catch Commission, sees no harm in now, after five years, stating that his personal opinion at present does not exactly correspond with the collective opinion expressed in paragraph 168 of the report, as he now considers that the Undeutsch device might have been excepted from the statement that the Commission was not wholly satisfied that any one of the safety catches tried entirely met the requirements of such an appliance. The Undeutsch safety catch was several times tested, and each time successfully. The official report of the final test was as follows:—

Description.—The device consists of four lever arms, one pair to each wooden runner or guide, each arm being hinged to the body of the cage and terminating in three vertical blades one and three-sixteenth inches long. These arms are thrown up into action by levers actuated by a spring on the king-bolt of the cage when the winding rope breaks or is detached from the cage. After the blades have once come into action, they are forced further into the guides by the falling cage, until the lever arms come into contact with adjustable stops which limit the penetration to a certain definite (prearranged) amount determined by a consideration of the total weight of the cage and load.

Description of Guides.—The guides consisted of four inches by four inches pitch pine, which had been in use for several years, and had worn down to about three and three-quarter inches by three and three-quarter inches.

Compartment in which trial was made.—North compartment.

Trial No. 2.—Weight of cage, 1,400 lbs.; weight of safety device, 895 lbs.; load in cage, 1,727 lbs.; total, 4,022 lbs.

Grips.—The stops for controlling the amount that the grips were allowed to penetrate the guides were set in such a manner that the points of the blades could close in to a two-inch gap.

The cage was raised to the level of the surface, and was then given a run down four hundred feet, when the rope was automatically disconnected from the drum, allowing the cage to fall with four hundred feet plus eighty-two feet (distance from position of cage in headgear to engine) of rope.

The catches came into operation almost immediately, and the cage was brought to rest in a distance of thirty feet. The speed of the cage at the time of disconnection was about two thousand five hundred feet per minute. Time of run, thirteen seconds. No damage was done except that the grips penetrated the guides about half an inch on each side, scoring out that amount of timber. The instrument used for measuring the shock registered about three and a half inches "free fall."

When the stringent conditions of the test just described are carefully considered, it must be admitted by everyone that no more absolute proof of the reliability of the safety catch could possibly be arranged. If the writer had not been completely satisfied on this point he would have arranged for further trials. It was not considered safe, from the condition of the shaft timber, to use a load of weight much in excess of two tons, and the speed attained was all that the engine-driver could manage to reach. Moderation in these two points was not dictated by any question as to the

reliability of the safety catch, but solely on consideration of the existing circumstances.

As stated previously, and as proved at the Marcus shaft trials, the shock is practically independent of the velocity, and its amount can be regulated by the setting of the stops which control the penetration of the knives. Greater energy of fall—and this quantity takes account of both weight and velocity—gives rise to greater length of travel, but to no increased shock.

The one point on which the Undeutsch design is not entirely satisfactory is that it does not automatically adjust the depth of penetration of the knives at places where the wooden guides are badly worn, but, in practice, this does not appear to matter much, contrary to what has been found to be the case with using the wedge principle. The guides at the Marcus shaft were considerably worn, and unequally, still the shock and braking distance were but little affected.

It may be noted here for the benefit of local engineers that the Transvaal patent on the "Undeutsch" safety catch has now lapsed.

The late Oberbergrat Professor Undeutsch, of Freiburg, Saxony, who made a prolonged and very successful study of the theory and mechanics of the safety catch, enunciated as his leading principle that the brake resistance R, the retardation P, and the shock in passing through a braking distance S, should remain constant as long as the mass M (or the weight Q=M.g) remained constant. This leads to a constant catching force F, and F=Q+R; or, the braking resistance per unit weight $r=\frac{F}{Q}-I$.

The retardation $P=\frac{R}{M}=\left(\frac{F-Q}{Q}\right)\times g=\left(\frac{F}{Q}-I\right)g=$ constant. Now, $\frac{F}{Q}$ is the unit (per unit weight) of catching force, and $\frac{F}{Q}-I$ is the unit of brake resistance, and to obtain a retardation "P," i.e., to stop the falling load Q in a certain distance, $\frac{F}{Q}$ which is greater than $\frac{F}{Q}-I$, must be greater than zero, so F must be greater than Q.

The value of $\frac{F}{Q}$ is therefore a measure of the shock of catching, and, as this has to be small, for a constant Q, both P and F should be small, but not so small as to too greatly reduce the factor of safety of catching.

In constructing, therefore, a safety catch on the "destructive" brake principle, F the catching force, and in consequence the depth of penetration T, should remain unaltered for given conditions, and if Q is increased the retardation P is reduced. Or, conversely, if P and the shock are to remain of the same magnitude, F and T must be regulated to suit any alteration in the load Q. The Undeutsch safety catch is capable of ready regulation in this respect, and T can be varied from zero to a designed maximum which is to correspond with the largest probable value of Q.

From the principle of conservation of energy, $R.S=\frac{M v^2}{2}$ . . . where v=the downward velocity of the cage at the moment the catches have fully engaged; i.e., $(F-Q)\ S=Q\frac{v^2}{2g}$ . . and since $\frac{v^2}{2g}=h=$height of free fall. $(F-Q)\ S=Q.h$; or $\left(\frac{F}{Q}-I\right)=\frac{h}{S}$ that is to say, the unit of brake resistance $\left(\frac{F}{Q}-I\right)$ can also be expressed by the ratio $\frac{h}{S}$. Now, $P=\left(\frac{F}{Q}-I\right)\ g=\frac{h}{S}.g$; so that, if "h" and "S" are settled upon, the unit brake resistance $\left(\frac{F}{Q}-I\right)$ and the unit catching force $\frac{F}{Q}$ are known, and if Q is settled upon, F is directly determined. T, the desired penetration, then follows, from experimental data. Similar reasoning to the above may be used in the design of a "friction" safety brake, and the coefficient of friction for steel on steel, or iron, or wood, should not be assumed as greater than 0.125.

The chief criticisms directed against the use of safety catches are: (1) With a good winding rope safety catches are unnecessary; (2) if the inspection of the rope is casual and faulty, so is certain to be the examination of the safety catches, and both will fail if the first-named does; (3) the safety catches are themselves a source of danger due to the possibility of their coming into action when not required.

A SENSATIONAL CASSITERITE FIND.



Block of Ore from Anglo-German Tins Property, German South-West Africa.

In answer to contention (1), the accident which occurred at the "Lohse" vertical shaft of the Simmer and Jack East Gold Mining Company, Ltd., on October 19th, 1906, has only to be cited. The winding rope was in perfectly good condition, but was fractured while being unwound by reason of its coming into contact with the sharp head of a countersunk bolt, which had worked loose on the inner flange of the drum of the winding engine. As the rope was unwinding, the bolt worked out, protruding over the last turn of the upper layer of rope, which caught on the bolt head. The sharp bend and sudden retardation in motion caused the wires to be severed as if in a powerful shearing machine. The cage was then seven hundred and fifty feet from the surface, and fell with its twenty-three occupants a distance of one thousand two hundred feet to the bottom of the shaft. Safety catches of the ordinary eccentric cam pattern were fitted, but these, of course, are useless in the case of a descending cage and a "tail of rope." The angle of entry of these safety catches was also too bluff for successful initial action. Slight scrapes were found on the wooden guides and the teeth of the cams were choked with wood pulp.

A further melancholy illustration of the fallacy of the "good rope" theory is the accident which occurred at the No. 2 main incline shaft (60°) of the Vogelstruis Estates and Gold Mining Company on February 23rd, 1910. As the sinking skip was ascending from the thirteenth level, carrying the mine overseer, the skip-man, and four natives, a mass of rock, which had fallen from the hanging of the shaft between the eighth and ninth levels, fell down the shaft, struck the skip at about the nineteenth level, and snapped the winding rope. The skip and rock went down the shaft, and all the occupants were killed, as well as five more natives at the bottom of the shaft.

Fracture of axle of pit-head sheave, or the winding rope leaving the sheave, are accidents that have many times accounted for the snapping of a sound rope. Besides the consideration of the soundness of the winding rope itself, which it may be noted may at any time be seriously and immediately impaired if any "kinking" should occur, there are to be taken into account the possibilities of failure in the capping or in the other connections between the rope and the cage.

With respect to contention (2), it is only necessary to remark that inspections should be thorough, and that the examination of a simple safety catch such as the Undeutsch may be carried out much more easily and rapidly than in the case of a winding rope of any considerable length.

Contention (3) has done duty for many years as the great bogey set up by "thoughtful mining engineers" to scare the advocates or intending users of safety catches. The late Sir Warington Smyth, in his contribution to the discussion on Sir Frederick Abel's paper on "Mining Accidents and their Prevention," at the Institution of Civil Engineers in 1887, quoted the opinion of these gentlemen as considering that "By adding an apparatus of that kind, they were merely introducing a new source of danger."

The Dortmund Commission laid down the common-sense principle that "Safety catches should be retained as long as it cannot be proved by statistics that they cause more accidents than they prevent." Having carefully examined all available statistics, this Commission stated that it was conclusively proved that on several occasions safety catches prevented loss of life, while there was no case on record of any person having suffered severe injury, or of any deaths, due to the action of the safety catch. It was recognised, however, that the fact that the safety catches may come into action when not required constituted a grave source of danger, in that the catches might free themselves when the weight of the slack rope accumulated on the cage, and the subsequent fall would inevitably break the rope. The writer considers that a good safety catch should not be open to this reproach. Firstly, the tension in the spring which actuates the catches should be as small as possible (consistent with their weight and that of the other operating mechanism) so that the greater part of the weight of the empty cage and the whole of its contents would have to be taken off the king bolt before the catches would come into operation. Secondly, the tendency and capacity of the catches to grip more tightly as the load on the cage is increased, which is a most desirable quality up to a settled maximum, can be readily ascertained by a statical test in the headgear, protective baulks being placed over the collar of the shaft.

The writer has known of two or three cases of safety catches coming into operation when not required. These were due to jerky lowering when the cage was not far from the collar of the shaft—the catches held properly and no damage was done. In these cases the load on the king-bolt spring was excessive, and after its reduction no trouble occurred subsequently.

An accident occurred at the Wolhuter Deep Gold Mining Company on January 20th, 1907, in which six natives were killed and four injured. The shaft was in course of sinking and about one thousand two hundred feet deep, and the skip in which persons were being

THE TIN FIELDS IN PICTURE.



Power House under construction, Zaaiplaats Mine.

raised in No. 5 compartment was overturned owing to its fouling with a bight of slack rope which had intruded from the adjacent compartment No. 4. The safety catches of the skip (and thirty feet extension guide frame) in No. 4 compartment were found to have acted about one hundred feet from the bottom of the shaft, and slack rope resulted for the remainder of the trip. Upon examination after the accident, with the safety catches put out of action, it was found that, owing to the limited clearance between the thirty-foot guide frame (the runners of which were not perfectly true) and the steel guides of the shaft, there was jambing on the descent, and if the driver had not been immediately signalled to stop, slack rope would have been paid out. This case goes a long way to convince the writer that many cases of winding ropes breaking, reputed to be due to safety catches acting where not required, accumulation of slack rope and subsequent free fall of cage, are in reality primarily due to the cage sticking in the shaft while being lowered. Many such cases of ropes breaking in this way have occurred on the Rand in the case of the balanced winding of rock in which safety catches, from their absence, could not be accused of playing any part.

It is right and proper for the safety catch to act when the descending cage sticks in the shaft, but the catch should be of such design that the accumulated weight of slack rope only leads to a greater grip on the guides if the maximum is not already reached.

Perhaps enough has been written now to show that the safety catch is a most desirable fitting, and that it is non-dangerous in so far that it does not introduce any new danger into the winding operation.

To obtain safety catches suitable for winding in vertical, incline, or compound shafts, and with timber, steel, or wire rope guides, is a quest worthy of approval. Each case has probably to be treated separately, though the guiding principles are the same.

Inventors still devote much time and attention to the problem, and the patent records published weekly in the engineering periodicals generally contain drawings and descriptions of one more attempt at its solution. Unfortunately, these inventors generally have not the knowledge of what has previously been accomplished in the matter of design or test. The report of the Transvaal Commission (1907) was widely published, but it has not proved so generally educative as might have been anticipated. Even locally in the Transvaal little notice has been taken of its teachings.

Paragraph 161 of the report states: The "White and Grant" eccentric safety catch was tested in order to demonstrate finally its unreliability, and Annexure 3 gave full details of the tests which showed that with a descending cage and a "tail of rope" this catch will not act successfully. In spite of this fact, many safety catches of this type have been fitted to cages operating in new shafts on the Rand during the past five years, the Undeutsch device not yet having been commercially exploited on these fields. Several designs of safety catch have also been submitted to the Standing Committee which obviously did not possess the desirable qualities enumerated in paragraph 154 of the report. In other parts of the world, journals devoted to mining engineering frequently contain illustrated articles dealing with some newly arrived safety catch for which a successful future is anticipated, but which can plainly be seen to be unreliable. The writer, therefore, felt that an article like the present one was necessary, and that it was desirable to once again publicly state what work the Transvaal Commission had accomplished and what qualities and attributes they had found to be necessary in the case of a safety catch. These latter are thus set forth in the report:—

(1) "The instantaneous release of tension in the rope, at the time of its fracture, must immediately be taken advantage of through the medium of some spring connection (not necessarily metallic) to operate, by one means or another, the retarding agency. The releasing of a weight without any spring impulse is not likely to be effective, as it is difficult to attempt to disturb in this way the natural zero relative motion of all the moving masses.

(2) "The movement of the spring can be best utilised to create a small relative motion of the draw-bar (king bolt) of the cage.

(3) "The motion of the draw-bar should be utilised to work the brake mechanism in a so far non-reversible manner that, once the brake is in action, it will require an actual raising of the cage, or a rope pull equivalent to it, to release it in the slightest degree.

(4) "The tension in the spring should be as small as possible, certainly not more than half the weight of the empty cage, so that the catches shall not be brought into action when not required, owing to the pulsations of the winding rope.

(5) "Seeing the instantaneous nature of the operation, and the small force disposal to effect it, the weight of the actual moving parts should be reduced to a minimum.

(6) "The force necessary to produce any retardation in a falling body must be at least equal to the weight of the body itself. If this force is only equal to the weight of the body, then no retardation occurs, the force of gravity is exactly neutralised and the body continues in uniform motion downwards with the velocity it possessed at the instant of the application of the force. It is, therefore, necessary to supply something more than this, if the body is to be stopped.

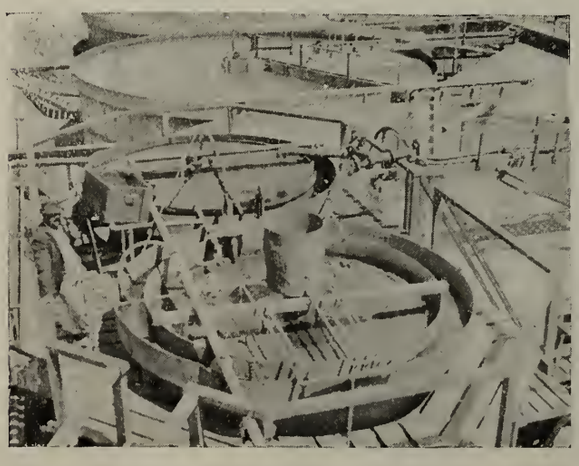
"The difference between the catching force (supplied by the safety catch) and the weight of the loaded cage is the amount available for retardation. On the amount of this difference, and on the suddenness of its creation, depends the shock to the occupants of the cage and also the braking distance, this latter being also influenced by the velocity of the cage, the relation being directly as the square of this velocity.

"The retarding action of a good safety catch should, therefore, conform with these principles, and secure the arrest of the cage, even on the downward journey, without injury to the occupants.

(7) "The retarding force, whether produced by deformation and friction with wooden guides, or by friction on steel guides, should be, within practical limits, independent of the amount of reduction in size due to wear that the guides have previously sustained.

(8) "The direction of application of the retarding force should be such that the guides and their supplementary framework are maintained in position.

RAND MINING IN PICTURE



Simmer and Jack Black Sands Plant.

(9) "The safety catch, having stopped the cage, should maintain it in position until it is again lifted.

(10) "The safety catch should be equally reliable in its action whether the rope breaks on the ascending or descending trip.

(11) "The mechanism should be capable of ready examination, and designed with due consideration to the severe working conditions that it has to meet with in mining practice."

Referring to condition (1) set forth above, it has to be especially emphasised that, provided the shock created remains within a safe limit (not more than equivalent to four inches "free-fall" according to some authorities), the more rapidly the safety catch comes into its fullest action the better, needless excess of velocity of descent thereby being prevented. Much ingenuity has been expended on the invention of "screw-up" devices. It has, therefore, to be pointed out that these are wrong in principle. The "delay-action" valve is a useful fitting to a "deck-discharge" torpedo, as it prevents the engines racing by delaying the admission of full air pressure until the torpedo is fully immersed in the water. The safety catch of a mine cage, however, requires no "delay-action" device, or on the breaking of the winding rope the conveyance will race downwards with too great a velocity before any retardation is supplied.

The work accomplished by the Transvaal Commission proved that it was possible in vertical shafts with wooden or steel guides to use an automatic safety brake which would bring the cage to rest in a reasonable distance with no dangerous shock in the event of the winding rope snapping, even in the most unfavourable position, i.e., when a long tail of rope is attached to the falling conveyance. It showed that the eccentric catches were unreliable, that "wedge" catches required stops to limit the travel of the wedges, and that knife-blade catches (such as the Undeutsch) were the most reliable in the case of wooden guides unequally worn.

It remains for practical tests to be made in Great Britain with selected designs of safety catch from among the large number patented in that country for use with wire rope conductors, and, on the Rand, for a catch to be produced which could be satisfactorily fitted to the self-tipping skips commonly used in incline shafts.

In this, the "coming of age" issue of the "South African Mining Journal," the preceding notes appear somewhat appropriate as dealing with what may be described as a period of twenty-one years' muddling with the safety-catch question (1886-1907), due to ill-concerted effort, misdirected energy, and prejudice. It is the earnest wish of the writer that his attempt to bring together the rights and wrongs of the subject in such a popular publication as the "South African Mining Journal" may be successful in sustaining the interest of the inventor in his quest for a novel and satisfactory safety catch, and spare him the great waste of energy that repetition and travelling in wrong directions involve.

RAND MINING IN PICTURE



A Typical Cyanide Plant

Rhodesian Gold Mining in Picture



Gatooma in the Early Days



The Queen's Mine Matabeleland



A Typical Rhodesian View

RHODESIA

A Review of Mining and Metallurgy in the Territories of the British South Africa Company

Southern Rhodesia

THE history of Rhodesia, as Rhodesia is known to-day, is the history of the British South Africa Company. Founded in 1889, the Chartered Company had as one of its main objectives the exploitation of the mineral belts of Matabeleland and Mashonaland, and very shortly after the pioneer column—that little band of plucky pilgrims who founded Rhodesia's destinies—entered the country a start was made on prospecting the various grants of areas made by the company to mining ventures and concessionaires. The War with Lobengula, his flight from Bulawayo, the slaughter of Major Alan Wilson's little column on the Shangani River, and the subsequent conquest of the powerful Matabele and occupation of the chief town of their late king—these are incidents in the thrilling story of Rhodesia known to every schoolboy, and perhaps more befitting a history book than an industrial review. Yet one can scarcely refrain from alluding to such events, for they have had most important influences on Rhodesian progress, Rhodesian people, and Rhodesian character.

Occupation and the Dawn of Industry.

After the flight of Lobengula and the occupation of Matabeleland came the formation of initial syndicates, and later on of companies, to work properties that had been selected. Though many companies were formed, and some with big capitals, nothing very considerable was done until early in the nineties, and then there occurred wild speculation. A considerable amount of rough-and-ready work was done under enormous difficulties. There was a period of pause brought about by the native rising of 1896. Thereafter matters were greatly improved by the completion, towards the close of 1897, of the railway extension northward to Bulawayo. By 1898 some companies were in such a forward state that a commencement of gold production was effected. But in a great number of cases many companies well-nigh had reached the end of their financial tether, and it took a year or two for a slow recovery of confidence on the part of the investors, who, however, were encouraged by the commencement of production.

Notwithstanding the many previous troubles—native risings, rinderpest, droughts, etc., and the outbreak of war in the Transvaal—a considerable amount of work was done even during the war. On the signing of peace further progress was made, but not until 1905, when the B.S.A. Company granted special facilities to small workers, did the gold output of the country assume any really large dimensions. The excellent returns secured by the tributing and prospecting syndicates gradually brought a measure of returning confidence to the country, and as at the same time numbers of the larger and more important mines reported much improved developments and began to declare dividends, there resulted in 1909-1910 a general scramble for ground; in fact, something remarkably like a "boom" ensued. In 1909 there came, in addition to excellent deep developments in the Globe and Phœnix mine, discoveries of the Shamva banket deposits (Abercorn region) to the north-east of Salisbury. The attraction of additional capital, both to banket and to other districts, brought about a revival of interest in the share markets—and, indeed, it may be said that a feature of 1909-1910 was the wave of speculation that occurred. Numbers of new companies were formed to acquire and exploit claims, and all sorts of wild anticipations were to be heard as to output and profits.

The Position To-day.

The inevitable aftermath has occurred, and Rhodesia is regarded as a mining field to-day severely in the doldrums. As a matter of fact, the country has maintained its mineral output in face of very considerable difficulties. Indeed, production has increased somewhat, whilst at the same time development has been pushed ahead far more energetically than ever hitherto in the history of the country. And development, ore reserves, and footage are admittedly Rhodesia's greatest needs.

Certainly the most important statement made by Mr. George Mitchell, M.L.C., at the last annual meeting of the Rhodesia Chamber of Mines was that relating to development work and ore reserves. Mr. Mitchell said development had progressed at a rate surpassing anything that had previously been attempted in the territory. A reliable estimate of the ore reserves prepared by the Chamber showed that the developed payable ore in sight at the present time was no less than 6,280,908 tons, containing gold to the value of £13,019,226, or sufficient to maintain the present output for a period of five and a half years. No mines belonging to small workers were included in the foregoing estimate, though this class of mine was responsible for 26 per cent. of the output. The figures relating to the industry were, he said, such as to show there was going to be no diminution in the activity of the industry.

An early or marked rise in the gold yield of the territory was not, he said, expected at the moment, but it was evident that with developments now proceeding on all sides, with the projected railway extensions, the day of very largely increased gold declarations was approaching.

A Dip into the Past.

Such, in brief, is the history of Rhodesia, and more particularly the mining history of the vast and fascinating land which will for ever keep the memory of that great man whose name has been given to the country bright in the memory of the Empire. Perhaps it would be better to characterise the brief chronological review given above as reflecting the modern history of Rhodesia only, for Rhodesia, unlike the Witwatersrand, is a land wherein gold mining has a history of production and activity buried deep in the sands of centuries.

The great weight of archæological and scientific opinion of to-day favours the view that Southern Rhodesia, and particularly Mashonaland, was that Ophir wherefrom Solomon gathered riches in the days of the Book of Kings. Certain it is that a tremendous amount of mining was carried out in Matabeleland and Mashonaland long, long before the hardy old Portuguese explorers of the sixteenth century penetrated into the kingdom of Monomotapa. The argument—nowadays propounded by a distinct minority—that the Zimbabwes of Mashonaland were built and the old mines of Rhodesia, many of which are of remarkable size and depth, were exploited by people of Bantu descent and origin has very little to support it. Apart from the fact that the fingers of history and geography point strongly to Southern Rhodesia and the adjacent province of Manicaland as being the country from which the Phœnicians largely obtained their wealth, it is not compatible with common logic to suspect a southern negroid race of having built the ruined cities and half-demolished temples of Southern Rhodesia, for these people are absolutely lacking in architecture. And had they extracted such enormous quantities of gold as the old mines and heaps of rubble scattered throughout Rhodesia seem to indicate, surely some of this wealth would have remained in the country. As a matter of fact, old gold ornaments and smelts are very rarely come across, and it is obvious that the great bulk of Southern Rhodesia's production was exported. Matabeleland, Mashonaland, and Manicaland satisfy all the historical and geographical requirements of Ophir, and without going deeply into archæology, it must be said that, in the opinion of the writer, the evidence is overwhelmingly in favour of Sabæan industry and influence as preached in the doctrines of Mr. A. Wilmot, Mr. R. N. Hall, Dr. Carl Peters, and Sir Alfred Sharpe, and in opposition to the views of Professor Randall McIver and others.

Ancient and Modern Outputs.

It may be asked why any extended reference should be made to Rhodesia's ancient history in a modern article appearing in a modern mining journal and dealing with modern methods and achievements. The answer is that attention was first directed to Rhodesia as a possible gold yielding field of importance in the seventies and eighties because of the prevalence and wide distribution of ancient workings. When, after the occupation by the pioneer column, "Zambezia," as it was then often named, came to be explored, the belts of the old-day mining activity attracted first notice and were the first to be exploited. It is not, indeed, an exaggeration to say that quite eighty per cent. of the mines have been opened up on ancient pits, surface trenches, crude drives, and adits. These miners of the predynamite, precyanide epoch only concerned themselves with the very richest ore. Rock that many a Rand mine manager would like to see in his stope faces was discarded, and this refuse constitutes the large dumps of what is nowadays termed "rubble" to be found all over the country.

It has been estimated, from an examination of a large number of rubble heaps and a calculation as to the number of cubic feet or tons of rock extracted from the ancient workings of Rhodesia, that about seventy-five million pounds worth of gold (some estimate a much higher amount) was won from Rhodesia before even Selous sought permission from Lobengula to slay elephants. Practically all of this, it is reckoned, was carried away before the commencement of the Christian era.



Map of Rhodesia, showing Principal Mining Districts

As to modern Rhodesia, the fact may be recorded with pride that up to date gold of a total value of £21,000,000 has been produced, whilst the value of other minerals has amounted to £1,300,000.

The Advance in Production.

Several years elapsed after the occupation of Rhodesia in 1890 before any really attractive results were obtained from mining. It has been said that the names of all Rhodesia's curses and obstructions have commenced with the letter "r"—rebellions, rinderpest, and redwater might be advanced in support of this assertion; but, on the other hand, Rhodes and railways, the country's founder and the country's salvation, have the same first letter.

What time Jameson and Colquhoun, and the earlier high officials, were struggling with risings and rebellions and stock-devastating diseases, Rhodes was urging for the construction of the line to the north. In 1891, despite Cape Government opposition, the first section—Kimberley to Vryburg—was laid, and two years later construction of the line to Bulawayo was commenced. Faced with Matabele and Mashona revolts, transport difficulties, and a thousand and one other disadvantages and troubles, the mining industry had not, during the first two or three years of the Rhodes' occupation, any real chance of, or reason for, progressing. Furthermore, in the earlier days of Rhodesia the management was of a peculiarly wild and irresponsible type. The nature of the reefs was not understood, and over-capitalisation and over-equipping could be laid at the doors of practically every mining company prosecuting operations in Charterland. Gradually, however, matters improved. With the effectual stamping out of the native revolts and the opening up of Rhodesia by railways, more stable conditions began to make their influence felt on Rhodesian mining. Prior to September, 1898, the gold output of modern Southern Rhodesia amounted to only £23,465. But about this time the country began to climb the first real staves in the ladder of production. In the period to June, 1899, 80,252 short tons were crushed for a return of £176,447. Next year £209,682 was declared, and by March 31st, 1901, the output had risen to a third of a million per annum. Since that date the statistical history of Rhodesia shows slow but steady and almost unbroken progress.

In order more clearly to demonstrate the growth of production, the following monthly record of the value of the gold output from Rhodesia to date is appended:—

Monthly Record of the Value of the Gold Output from Rhodesia to Date.

	1912.	1911.	1910.	1909.	1908.	1907.	1906.	1905.	1904.	Summary	
	£	£	£	£	£	£	£	£	£	1898	£83,052
January	214,918	207,903	227,511	204,666	199,380	168,242	155,337	115,128	70,442	1899	205,690
February ...	209,744	203,055	203,888	192,497	191,635	145,397	137 561	107,307	67.800	1900	308,249
March	215,102	231,947	228,385	202,157	200,615	167,424	160,722	124,428	64,895	1901	610,389
April	221,476	221,296	228,213	222,700	212,935	175,210	157,108	117,912	65,175	1902	687,096
May	234,407	211,413	224,888	225,032	223,867	189,216	169,218	112,384	71,521	1903	827,729
June	226,867	215.347	214,709	217,600	224,920	192,506	170,083	125,926	75,745	1904	969.343
July	240,514	237,517	195,233	225,234	228,151	191,681	173,313	122.284	87,839	1905	1,449 985
August	—	243,712	191,423	228,296	220,792	192,106	178,999	127,643	87,993	1906	1,985,099
September ...	—	225,777	178,950	213,249	204,262	192,186	173,973	125,904	93,047	1907	2,178,886
October	—	218,862	234,928	222.653	205,466	191,478	161,360	119,657	90,088	1908	2,526,007
November ...	—	214,040	240,573	236,307	196.668	183,058	175,655	117,856	94.283	1909	2,623,788
December ...	—	217,026	199,500	233,397	217,316	190,384	171.770	133,555	100,515	1910	2,568.201
										1911	2,647,895

The production of other minerals has been as follows:—

Silver	1,437,994 ozs. or	£158,170
Lead	6,119 tons ,,	79,244
Coal	1,203,840 tons ,,	548,775
Copper	359 tons ,,	23,452
Precious stones.		39,115
Chrome iron ore	161,634 tons ,,	376,034
Tungsten minerals ...	125 tons ,,	11,197
Asbestos ...	1,119 tons ,,	12,992
Antimony ...	14 tons ,,	275

This makes a grand aggregate for mineral production of over twenty-one and a half millions sterling.*

Other important statistical tables which call for mention relate to dividends and labour.

Dividends.

In regard to dividends, progress has been particularly marked and gratifying, as the following table, which states the profits distributed by the gold mining companies alone for the past ten years, sets forth:—

1902	£98,475
1903	64,200
1904	6,125
1905	45,000
1906	62,812
1907	112,113
1908	96,551
1909	161,875
1910	431,347
1911	584,128

The Eternal Labour Problem.

Rhodesia, like the Transvaal, has ever before it a mighty and troublesome problem—that of labour. In the earlier days of mining in the country, those responsible for the exploitation of the mineral belts lulled any sense of anxiety they may have possessed by pointing to the large native population. Time, however, has proved that Southern Rhodesia has had to look beyond her frontiers for the greater proportion of her unskilled labourers.

The annual report of the Executive Committee of the Rhodesia Chamber of Mines gives the following summary of the average number of native labourers employed on Southern Rhodesian mines during the past year and compares them with the two previous years:—

	1911	1910	1909
Local	14,327	12,738	10,689
Portuguese Territory ...	6,942.	6,925	6,116
N W. Rhodesia	4,730	4,127	4.436
N.E. Rhodesia	6,710	5,134	4,854
Nyasaland	4,944	6,520	5,074
Other sources	1,003	1,610	1,551
	38,656	37,824	32,720

With the growth of the industry, the demand for labour has naturally increased year by year, and various measures have been suggested and considered with a view to improving matters and augmenting the supply. The importation of Chinese has been clamoured for, but as yet no drastic move has been made in the direction of employing aliens, and the mines continue to be operated by such local supplies as are available and by labourers drawn from North-eastern and North-western Rhodesia, Nyasaland, and Portuguese Territory. The recruitment and distribution of native labour in

* To end of March, 1912.

Rhodesia is carried on by a Native Labour Bureau, which has established depôts throughout the Southern and Northern Administrations and in the adjacent territories. This concern is governed by the mines and the Government. It recently has been reconstructed and reorganised, and although disappointment is often expressed at the results secured, it must be conceded that the bureau has carried on, and is carrying on, excellent work under exceptional difficulties: for instance, competitive recruiting, antagonistic members, stringent Government regulations, and, in certain parts of North-eastern Rhodesia, sleeping sickness.

The Geology of Rhodesia.

The "High Veld" forms the backbone of Southern Rhodesia, and is composed almost entirely of metamorphic rocks. Here, too, are great granite bosses which have intruded into them from below now exposed at surface through weathering and denudation. The younger rocks of sedimentary origin are for the most part confined to the low-lying country, but at times are to be found overlapping on to the rocks of the High Veld. Overlying both the aqueous rocks and the High Veld system are to be found various recent deposits, such as surface limestone, tufa, concretionary limonite, river gravels, and sinters.

Rhodesia is a country of amazing geological and mineralogical complexity. All sorts of rocks and minerals and associations of rocks and minerals occur, and gold may be found in almost any type of formation. The great bulk of the precious metal has, however, been won from quartz veins, and these are usually confined to metamorphic rocks. There are, too, auriferous conglomerates, gold-bearing schists, and banded ironstones, and at many places gold is found in complex rocks along granite contacts. Gold has also been found in Southern Rhodesia in epidiorite, granulite, and in decomposed granite.

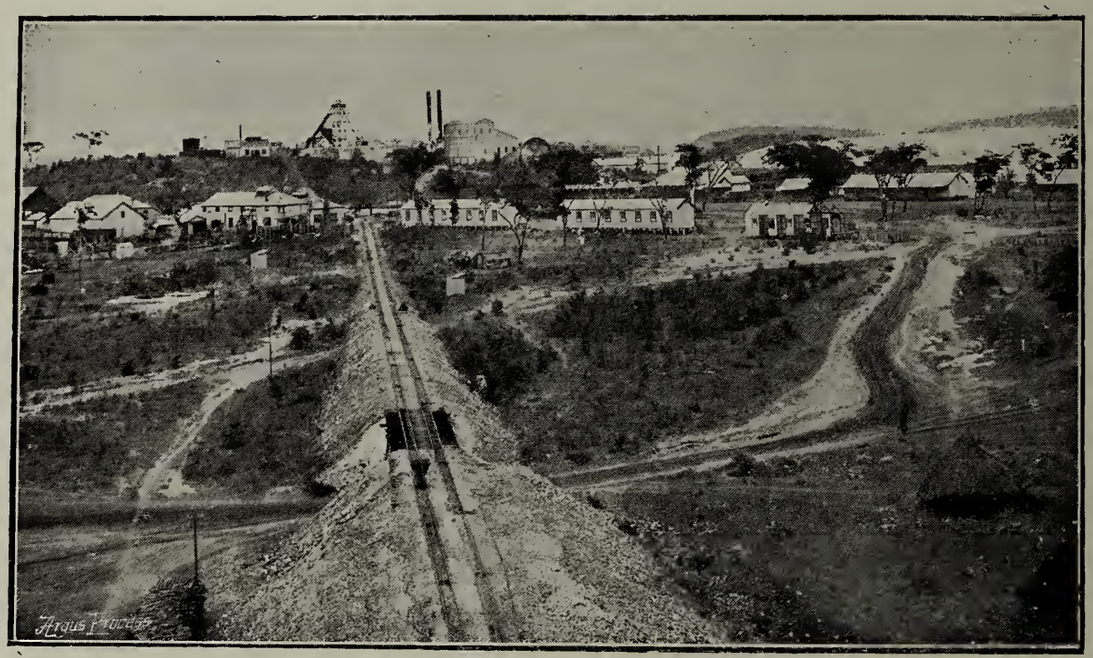
About two years ago the Geological Survey of Southern Rhodesia was initiated, with Mr. Maufe at its head. The Survey has already issued one important brochure, and regular reports and memoranda have been promised. The importance of thorough and expert investigation of Rhodesian geology can hardly be exaggerated, for the greater part of the country has been prospected in a peculiarly haphazard manner. In fact, as already stated, the majority of the mines have been opened upon ancient workings, and whilst it must be conceded that these workers of byegone days were discriminating miners, it cannot be presumed that they located all, or even a small proportion, of the profitable deposits of Matabeleland and Mashonaland. The great value of the Geological Survey to the country is thus apparent.

Some Typical Auriferous Deposits.

Hitherto Mr. F. P. Mennell has borne the great brunt and burden of Rhodesian geology. Without in any way reflecting on the excellent work achieved by gentlemen like Messrs. Franklin White, A. E .V. Zeally, and A. J. C. Molyneux, the statement that to Mr. Mennell belongs the major credit for the study, investigation, and elucidation of Rhodesia's many geological problems will universally be admitted to be true. Mr. Mennell groups the mines of the country according to "reefs" and "impregnations," and his classification of certain of the most important mines, which is here appended, is of particular interest and value. His geological grouping is then as follows:—

(1) Reefs.

(i.) In the Basement Schists: Globe and Phœnix, Surprise, Tebekwe, Bonsor.



Rhodesia's Leading Mine—The Globe and Phœnix

(ii.) In Banded Ironstone: Bristol, Veracity.
(iii.) In Conglomerate, etc.: Abercorn, Bell.
(iv.) In Epidiorite, etc.: Jessie, Antenior, Sheba.
(v.) In Granulite: Valley, Blanket.
(vi.) At Granite Contacts: Geelong, Colleen Bawn, Battlefields, Washington.

(2) Impregnations.

(i.) In Basement Schists: Gaika.
(ii.) In Banded Ironstone, etc.: Wanderer, Giant, Sabiwa, Golden Kopje, Concession Hill.
(iii.) In Conglomerate: Eldorado, etc., Riverlea.
(iv.) In Granulite: Ayrshire, Bushtick.
(v.) In Granite: Commonwealth.

In regard to the first-named mine—the Globe and Phœnix—it may be remarked that the excellent developments secured by this company in depth have been of the very highest importance, not only to shareholders in this particular company, but to Rhodesia in general. This is one of the oldest mines in the country. It is to-day both the deepest and the leading producer and dividend payer. Five years ago the outlook at this property scarcely could be termed satisfactory. One large portion of the property was accounted exhausted, and the work

proceeding on the lower levels in the other section of the mine, although resulting in good returns, was not without unfavourable features. During the last two or three years extraordinarily rich ore has been opened up on the sixteenth and seventeenth levels, and whereas at the end of December, 1908, the ore reserves amounted to 144,348 tons of 16 dwts. per ton value, they stand to-day at 179,427 tons averaging 35.6 dwts. per ton.

The fact that such excellent returns are being obtained from the deepest workings in Rhodesia unquestionably augurs well for the country and should do much to dispose of the pessimistic creed that nothing can endure for any depth or any length of strike north of the Limpopo. At the same time it should be recorded that Rhodesia is, for the greater part, a country of ' rich patches," reefs which "make" and disappear, and become enriched or impoverished in a manner which has justly earned for Rhodesia the not altogether enviable distinction of being a "tricky proposition." This phrase is used without, it must be distinctly understood, any prejudice whatsoever to the proved or partially proved ventures of size and a great measure of permanency, such as the Shamva, the Cam and Motor, and the Falcon, to mention but a few of the numerous very large propositions that have so far been discovered. The Shamva, at Abercorn, promises, indeed, to become one of the largest producers of gold in Africa.



The Wolfshall Mine, Selukwe

The gold deposits of the Abercorn district lie in a series of quartzites, shales, and ironstone conglomerates dipping at a high angle and lying between masses of horn-blendic granite on the Inyagui River on the south and on the Umfurudzi Valley on the north-east. Further east these masses unite, squeezing out the quartzites. Between the granite and the quartzite there lie usually very large intrusions of what appear to be diorite porphyry, while very large and strong dykes of diorite and a dense and fine-grained rock of which hornblende is the main constituent and which also appears to be a diorite, traverse both granite and sedimentaries. The series of quartzites and conglomerates which stretch from the back of the Shamva Hill across the Mazoe is a thick one, and contains innumerable beds of conglomerate. These bands appear in places to occur in lenses, dying out in strike, and the formation of the Shamva ore body has been compared to alternate layers of quartzite and conglomerate packed together like sardines. The Shamva ore body is not a new discovery; its extent on the surface has been pretty well defined by old native workings showing on the side of the hill for a length of between one and two thousand feet and a width of several hundred feet. The ground has been continuously held since the rebellion, and on the Cymric hill a similar but poorer ore deposit was for a time worked on a small scale.

The conglomerate series gives great hopes of future importance. So far development has been confined to three districts, Lomagundi, Abercorn, and Sebakwe. On the "Eldorado" and "Rowdy Boys" claims of the Rhodesian Banket Company at Lomagundi, good results are stated to have been obtained for several miles, and large quantities of ore have been developed in the Eldorado mine. The bulk of the pebbles here consist of granite, granophyre, rhyolite, and trachyte, whilst the matrix consists of green hornblende, felspar granules, epidote, biotite, and chlorite. A twenty-stamp mill with regrinding and cyanide plant started running in August, 1907. The plant has since been largely increased, and now consists of twenty stamps, two six-feet Chilian mills, eight Forwood-Down pans, and steel cyanide vats. The monthly output for a long time averaged about £19,000. In the Sebakwe area the Riverlea mine has worked intermittently a conglomerate deposit which contains numerous banded ironstone pebbles, and is generally considered to be of later date than that of the Lomagundi district.

It is among the old sediments that the most interesting and important types of impregnation deposit occur. Both banded ironstone and conglomerates are known to carry gold at a number of widely separated localities. The principal mines working in the banded ironstone beds and the associated schists in Rhodesia are: The Giant Mines and the Falcon Mine, Mashonaland; and the Wanderer, Matabeleland.

Giant Mines.—The formation worked here consists of banded ironstones in association with talcose and chloritic schists. The strike of the ore-body is practically north and south, and the dip to the east about eighty degrees. The schists are heavily mineralised, well-developed cubical and dodecahedral crystals of pyrites and irregular masses of pyrrhotite being freely distributed throughout them.

Falcon.—The Falcon mine, situated fifty-four miles east of Gwelo, in the Charter district of Mashonaland, is in a similar formation. There is a very large kopje

containing hornblende schist and quartzite, carrying gold and ores of copper—mainly malachite and chalcopyrite. Running parallel with this formation is a series of banded ironstones and quartzites. Adjoining the Falcon mine is another kopje containing a similar occurrence, and known as the Athens.

Wanderer.—This company is working a huge impregnation deposit about six miles from Selukwe in Matabeleland. The ore consists of a mixed quartzose and schistose rock in a much-crushed zone of banded ironstone. In this mine, too, conglomerate has, on the authority of some, been found, but it is not probable that a true conglomerate rock has been found there, though some specimens of crushed quartzite bear a distinct resemblance to "banket." There are other occurrences in the banded ironstones series in Rhodesia which are auriferous—the Camperdown, Concession Hill, Bristol, and Veracity, for example, but they are of lesser importance than the Giant, Falcon, and Wanderer propositions.

Having briefly dealt with some of the more important auriferous formations of the country, a short description of the base metal and other deposits should prove of interest.

Coal Fields.

Although gold has to date accounted for over ninety-four per cent. of the value of Southern Rhodesia's mineral yield, the country also possess coal and base metal deposits of large extent and importance. The chief coal field opened up to date has been at Wankie, situated two hundred and three miles north-west of Bulawayo, on the Victoria Falls line. Hitherto this has been the only productive coal field in Southern Rhodesia, but within the past eighteen months the Consolidated Gold Fields of South Africa have commenced on the development of a large coal field to the west of Gatooma. Coal occurs at several other localities, but last year, as usual, the Wankie Company monopolised the fuel output of the country and produced 194,200 tons, as compared with 180,068 tons in 1910.

The Wankie coal field comprises a depression of about one thousand square miles in extent, bounded on the north-west by the great fault which has let down the basalt of the Victoria Falls region against the coal measures. On the other sides are altered sediments, and the granites and associated schists seem to isolate it almost completely. A ridge of granite also protrudes through the beds near the middle of the field eastward of Wankie Colliery, and the structure of the field is, in the main, that of a denuded anticline, being quite unlike the usual basins. At the colliery the beds have a northerly dip, and there are two main seams of coal, of which only the lower has been worked.



The Old Mill at the Motor Mine

Copper.

Although the better known and presumably the most important copper areas of Rhodesia lie to the north of the Zambesi, cupriferous belts have been located at various widely separated areas in Southern Rhodesia. The production of this metal to date has not, however, been more than three hundred and fifty-nine tons, the great bulk of which has been won from the East Gwanda mines in Matabeleland. The Victoria, Lomagundi, Tuli, and Umtali districts each contain areas of cupriferous country, but for several reasons the potentialities of these have been more or less neglected. About a year and a half ago the South African Copper Trust, Ltd., was formed with a nominal capital of £375,000 for the purpose of taking over the assets of the Consolidated African Copper Trust.

The most important of the mines embraced by the operations of the South African Copper Trust is in all probability the Umkondo, a property situated in the Victoria district, and one which would, if located nearer the railway, have been a producer of some importance. Copper ores occur here chiefly as an impregnation in sandstones presumably of Waterberg age. On the taking over of the property by the South African Copper Trust, Mr. Henry Ewer Jones examined the mine, and, acting on his advice, the directors gave instructions for work to be commenced there. In the past, excellent results were obtained from the lode, and about 90,000 tons of ore containing 8 per cent. copper have been developed, the length of the pay ore being some 400 feet. A main shaft has been carried down to a depth of about 180 feet, and at 164 feet the top bed was met and found to be 4.5 thick, assaying 10.3 per cent. copper. An incline shaft has also been carried down on the reef to a depth of 145 feet, the average value being about 6.5 per cent. copper over a width of 51 inches, at which depth a fault was encountered and the reef lost. Another shaft, called the ventilation shaft, was sunk about 400 feet from the main shaft, and in this the ore body was expected to be reached, but after being sunk to a depth of 430 feet, the ore bed not being struck, work was abandoned. The engineer is of opinion that, in order to determine the nature of the fault encountered, it will be necessary to sink this ventilation shaft another 300 feet. This opinion coincides with that of Mr. F. P. Mennell, who, in his geological report, considers that there was a change of formation at the bottom of this shaft, where shale, similar to that exposed in the main shaft, was met with. The directors are therefore carrying out these recommendations, which it is estimated will cost £4,000, the data obtained from which will enable a definite programme of operations to be decided upon. The Edmundian mine is not in reality a Rhodesian proposition, as it is just over the border, and in Portuguese territory. It has, however, been financed and operated by Rhodesian companies, and has always been regarded in the light of a Mashonaland venture.

Operations here were suspended in September, 1911, in consequence of the breakdown of the plant. The position of the mine at that time was as follows: The main shaft had been sunk to the ninth level, at which point a station was cut. At the eighth level the reef, while similar to the upper levels, was found to be of shorter lateral extent, viz., 115 feet—as against 135

feet in the seventh level—the value being 13.5 per cent. copper over twenty-eight inches. A winze had been sunk seventy feet on the pay chute from this level, good ore being encountered, but at this point the reef became narrow, and sinking was discontinued. The engineer advised that the ninth level should be opened up before any definite opinion can be formed as to whether this falling off in the winze is merely a temporary squeeze, or whether it will seriously affect the future of the reef in depth. The engineer therefore recommended that a preliminary expenditure, estimated at about £7,500, should be undertaken for the purpose of repairing the power plant and opening up the ninth level. The work is now being proceeded with.

At Umtali there are several deposits of copper pyrites of prospective value, and the Penhalonga mine has produced a little copper as a by-product.

In the Lomagundi district, the Alaska mine, on which are very extensive old workings, has been opened up on an impregnation in limestone, the ore being chiefly cuprite and native copper.

Chrome Iron and Asbestos.

The Victoria district contains deposits of chromite connected with the serpentine rocks, and along the great picrite intrusion that runs right across the country from near Fort Impatene to the Zambesi deposits of chromite are found in several places, notably in the Hartley and Lomagundi districts. The Selukwe deposits occur about a mile from the picrite. According to Mennell, they may form an independent intrusion from the main mass ; on the other hand, it is not altogether impossible that they may be genetically connected with the much older serpentinised and dolomitic picrites intercalated among the schists. The ore is collected on the surface alongside the railway, and the supply is said to be inexhaustible. Other favourably situated localities may possibly be producing before long, but the low price renders a high quality and very exceptional facilities for working and transport absolutely essential to success.

To date, the deposits at Selukwe are the only ones that have been worked to any appreciable degree. The Selukwe deposits are of great extent and furnish excellent ore. During 1911 chrome iron ore shipments showed considerable expansion, and the formation of a chrome trust should help to improve prices. The output was 52,263 tons, as against 44,000 tons in 1910.

In the Victoria district there occur asbestos beds which have in the past yielded small quantities of this mineral. Owing to the great distance from the railway, asbestos is rather under a cloud at present. The deposits are, however, of promising nature, and the Victoria Railway should before long much improve matters.

Diamonds.

The final legal decision in the law courts of England in the cause celebre, De Beers v. the B.S.A. Company, whereby a virtual De Beers monopoly to all the precious stones in Southern Rhodesia was re-established, dealt a stunning blow to gem mining enterprise in Chartered territory. In consequence of the recent House of Lords decision confirming the De Beers Company's monopoly, there is likely to be very little prospecting for gems in future, as although it is true that a reward of £2,500 is offered for a payable "pipe," the ordinary prospector much prefers to look for something which offers possibilities of a less limited recompense. In commenting on the De Beers case, English papers have constantly asserted that no diamonds have been found in Rhodesia, or if such a sweeping assertion has not been made, it has, as a rule, been confidently stated that no true mine or "pipe" is known to exist. Even the latter statement is quite incorrect, as several "pipes" have been discovered, and the Colossus mine, near the Bembezi River is actually the largest one yet found in South Africa. It has produced a certain number of good quality diamonds, but the grade is evidently far too low to be payable. There is a recorded production from the Somabula gravels of over £30,000 worth of diamonds, besides other gems valued at over £8,000, and there can be no doubt that the quantity actually produced has been considerably in excess of the official estimate.

The geology of the Rhodesian gem-bearing areas is specially interesting, and a few remarks on the Bembezi and Somabula occurrences are here called for.

On the ground in the vicinity of the Morven mine, where most work has been done, numerous shafts have proved the existence of a pipe of large size, and trial washings have given favourable results in the way of diamonds. Below a covering soil and debris from ten to twenty feet in thickness the ground is of the usual character, having the ordinary calcite-bearing serpentinous matrix containing much ilmenite, pyrope-garnets, typical vaalite-mica, chrome-diopside, and altered olivine, besides a quantity of foreign rock fragments which include dolerite, granite, granophyre, "dunite," picrite, and "eclogite." The walls consist of coarse granite, except on the north-west, where there is some dolerite, and apparently also a mass of serpentinised "dunite." Magnetite, rulite, picotite, and grossularite have been noted among the concentrates from the machines. The diamonds themselves, it may be mentioned, are not at all like those of the Somabula field, but are white in colour, and are quite different in their crystalline form.

The sources of all the gemstones that had previously been produced in Southern Rhodesia are the old alluvial deposits of the Somabula Forest. The gravels and sands carrying the gems cover an area of a mile or more in width, and stretch northwards at least twelve miles from the watershed. They are newer than any other formation in Rhodesia, save the surface limestones, laterite, etc.; the agate, and even scolecite fragments which are found, proving their date to be subsequent to the lavas of the forest sandstones. This tallies with what is known of the age of the diamond pipes of the Cape, the Transvaal, and the Orange Free State, and naturally leads to the supposition that the diamonds are derived from rocks of the same age as those known



The Second Mill on the Motor Mine

elsewhere in South Africa. Beds of sand and even clay overlie or alternate with the gravel in various places, but the latter seems to carry nearly all the gems, its bottom portions being much the richest. The thickness of the beds is very variable, and sometimes reaches well over one hundred feet.

The gravel itself is composed of beautifully rounded pebbles in a matrix of sandy clay, sometimes ferruginous. There are some concretionary masses of iron-cemented sandstone, and the gravel is converted in places into a hard conglomerate by infiltrated iron or manganese oxides, or more rarely by silica. The pebbles are mostly of quartz, frequently rock crystal, but they also include jaspery banded-ironstone, chert, agate, hard sandstone or quartzite, and occasional large and small pieces of silicified wood, as well as fragments of granite and chloritic schist. Big boulders are comparatively rare.

Cassiterite.

The outstanding feature of 1911, in regard to base metals, was the discovery of cassiterite in various parts of the country. The three principal areas in which tin has been found are :—

(i.) In the Victoria District.

(ii.) In the vicinity of the Arcturus Mine to the east of Salisbury ; and

(iii.) In the vicinity of the Shamva Mine.

In each instance the tin stone has been found at the contact of the granite, and the archæan schists in which formation most of the important gold mines of Southern Rhodesia have been developed. In addition to the three localities above named, the presence of cassiterite has, it is understood, been determined in Matabeleland. It is as yet too early to write in any definite terms of the value of these discoveries. In the Victoria field the indications are promising, and, if only from a scientific point of view, it is of interest to learn that one or two rare and valuable minerals have been discovered in association with the tin stone. Several companies and syndicates have acquired interests in the Rhodesian tin areas, and the results of exploratory work will be awaited with considerable interest.

It does not augur too well for the future of the recent Abercorn discoveries that the Central Mining and Investment Corporation are reported to have abandoned their tin interests in that district.

Silver, Lead, and Tungsten.

The great bulk of the silver produced by Rhodesia has been yielded as a by-product of gold or else as a by-product of the lead recovered by the Penhalonga and one or two other mines in the Umtali district.

Tungsten ore has been discovered near Essexvale, in Matabeleland, whilst scheelite (calcium tungstate) has been worked in a small way near Umswezwe and one or two other localities in Mashonaland.

Rhodesian Railways.

As the iron horse has played such a very important part in the development of Rhodesia, a few words must be said under this head. Rhodesia is well served by railways. The Rhodesian Railways system carries passengers from Vryburg to Bulawayo. From here two main lines extend, the first going in a north-easterly direction to Salisbury and then running south-east to Beira, known as the Beira and Mashonaland Railways ; and the second running north-west to the Victoria Falls and then continuing north to the Congo border and styled the "Beira and Mashonaland Railways, Northern Extension." There are also branch lines from Gwelo to Selukwe, Gwelo to Blinkwater, and Salisbury to Lomagundi, where the Eldorado, Banket, and Ayrshire mines are situated.



The Jumbo Mine, Mazoe

Other connecting links in the system are forged between Salisbury and Abercorn, Gatooma and Eiffel Flats. The Victoria Railway will exploit a valuable agricultural district, which is also possessed of considerable mineral possibilities.

On all services comfortable coaches are in use, and on the main lines exceptionally well equipped dining cars are run.

There are two railway routes into Rhodesia from the coast : (1) From Cape ports, viâ Bulawayo ; (2) from Beira, viâ Umtali.

TABLE OF DISTANCES.

Southern System.	Miles from Cape Town.	*Eastern System.*	Miles from Beira.
Cape Town... ...	—	Beira	—
Bulawayo	1,362	Umtali	204
Wankie	1,574	Salisbury	374
Victoria Falls ...	1,642	Bulawayo	675
Salisbury	1,663	Victoria Falls ...	955

An examination of a map of Southern Rhodesia cannot fail to impress one with the extreme usefulness

of the Rhodesian Railway systems. There are indeed few mining districts which are not tapped either by the main trunk line of the Beira-Mashonaland and Rhodesian Railway system or else by branch lines constructed from the main trunk. Rhodesian mining, in fact, owes a great deal to the liberal policy of railway construction which has prevailed throughout Charterland. Southern Rhodesia is now crossed from west to east and from south to north by railways, whilst North-Western Rhodesia is traversed from the Zambesi to the Congo by the Northern Extensions line. In attempting a brief review of the progress of the mining industry in Southern Rhodesia during the year 1911, one cannot but refer to the important work of extending the railway from Salisbury to Mazoe, which has been carried out during the year under review. The continuation of the railway from Mazoe will open up a very important area, one which during the last two years has perhaps received more attention than any other in Charterland. Not only will the extension be of inestimable value to the Shamva Company, it will benefit a host of smaller concerns as well. Another important feeder line is that which has been built from the Cam and Motor property to Gatooma. This railway is only six miles long, but having regard to the manner in which the Cam and Motor property is opening up, it promises to be one of the most busily worked sections of the whole railway system.



The Queen's Mine, Matabeleland

Rhodesian Metallurgy.

Before proceeding to describe in brief some of the more important mines of the country, a few remarks are called for on the subject of technical practice.

In this regard, the mines of Rhodesia have undoubtedly witnessed numerous changes for the better during the past year or two. Particularly has this been the case in connection with metallurgy. Until recently there were not in vogue other methods of treatment for Rhodesian ores than milling and amalgamation, followed, perhaps, by rough concentration or cyanidation of sands in antiquated vats. Since, however, Rhodesian industry began to make real progress about three years ago, the many interesting and complex problems relating to ore treatment in Charterland have received a more fitting share of attention, and one finds to-day that Rhodesia can lay claim to such modern devices as Nissen stamps, Dorr slimes thickeners (in use, for instance, at the Hay Company's new plant), Pachuca vats (as at the Lonely), grinding pans, tube mills, filter presses, etc. Notwithstanding these innovations, there is still room for abundant improvement in Rhodesian ore treatment. Much useful work might be done by an institution modelled on the lines of the Transvaal Mines Trial Committee; an experimental organisation which would analyse the various types of ores and test the relative advantages and disadvantages of the various means of treatment advised for ores of different composition and value.

It is of especial interest to learn that at the Hay Mine, in the Mazoe district, an all-slimes method of treatment is being practised, that an interesting and novel scheme of treatment for the New Found Out ore has been devised, and that at the Cam and Motor a plant very similar to that of the Kalgoorli mine in Western Australia will be installed. The essential features of the scheme of treatment proposed for the Cam and Motor Company are double-stage rock breaking, drying of ore in cylinders, zinc crushing in ball mills, roasting in mechanical furnaces, fine grinding of roasted ore in cyanide solution by tube mills, filtration, final precipitation and smelting. In view of the somewhat refractory nature of the Eilcen Alannah ore, it seems probable that at this property also some out of the ordinary method of treatment will be necessary.

Underground Practice.

Of the recent development in underground work but little remains to be said, save that below surface organisation is in sad need of reform. This view can hardly be expressed in sufficiently emphatic terms. Things have changed greatly in Rhodesia of late, and it is common knowledge that the large limited liability company has not got anything like the efficiency out of the native labour forces of the country as the tributor or the small mine worker did. Neither has the large company secured such a measure of economy in connection with the use of stores, dynamite, mercury, etc., as the small proposition. It is, of course, only human to work better for oneself than for anybody else, and this is no doubt the underlying principle which makes for greater economy and efficiency in the case of the small mine and shows up the larger proposition to comparatively poor advantage. Still, it is very certain that large improvements are not only possible, but absolutely imperative.

Leading Gold Mines.

Having dealt briefly with the geological characteristics of the more noteworthy gold mines, a short review of the chief propositions in the country from the points of

view of development, production, etc., is called for. The Rhodesian gold output is fairly equally divided between the Provinces of Matabeleland and Mashonaland, although the production of the former Province is somewhat greater. The larger output of Matabeleland is in no small measure due to the Globe and Phœnix mine, near Que-Que, which, besides being the leading producer, profit-earner, and dividend-payer of the country, is, what is most important to note, the deepest venture in the country as well. The last statement as to ore reserves gave a total of 179,427 tons, having an average assay value of 35.6 dwts. per ton. The present equipment of the company consists of forty stamps and ten pans, but additional roasting plant, having as its mean object the efficient treatment of the stibinite ores of the mine, has recently been completed. Taking the output secured for the month of March as typical of the company's recent productive achievements, it is to be observed that 5,191 tons were crushed, the recovery from the mill being £35,058, from concentrates £2,353, and from slimes £2,290. The mine is admittedly an exceptionally high-grade concern, and the continuance of high values down to a depth approximating to 2,000 feet is as remarkable as it is gratifying. The capital of the company is £200,000, and the amount paid out in dividends last year was £320,000, or 160 per cent.

The Eldorado Banket mine in the Lomagundi district and the Giant Mines at Gadzema have been for long past "runners up" to the Globe and Phœnix in so far as productive operations are concerned. Both these mines have been under somewhat of a cloud of late. Messrs. H. A. Piper and H. E. Jones, consulting engineers to the newly-formed Gold Fields Rhodesian Development Company have, however, recently inspected the property and issued reassuring reports. This company distributed £90,000 amongst shareholders last year. For months past the Giant Mines of Rhodesia at Gadzema have been boring with a view to locating the lode below the sixth level. At about the sixth level between the old and new main shafts, a big lenticular mass of ore was encountered. In places the width of the ore body at this depth was no less than one hundred and forty feet. Early in 1911, however, this wide ore body was found to pinch out below the sixth level. A little more than a year ago, on the advice of Dr. Corstorphine, boreholes were commenced to be sunk below the seventh level. Various rumours have been in circulation as to the results of these borings, and accordingly much interest attaches to Dr. Corstorphine's latest report on the mine. The well-known geologist has stated his opinion that the exploratory boring already done has very far from exhausted the possibilities of the lode existing below the seventh level. The third borehole cut a mineralised portion of rock, to some extent resembling the body of ore. A borehole—No. 7—has been put down to intersect this. Borehole No. 8 has been located to go down vertically in a zone not yet explored, and to a depth greater than any previous hole. Even after completion of boreholes, other zones remain to be explored. The consulting engineer, it is interesting to observe, agrees with Dr. Corstorphine as to the direction of further boring, and states he shares the consulting geologist's opinion as to ultimate success. The recent not altogether satisfactory developments on the Giant have had a depressing effect on Rhodesia generally, for the Giant has always been regarded as one of the leading mines of the country and one which has perhaps more than any other given indications of permanency and endurance in depth. The ore bodies are lenticular in shape, and in places are of great width. The Giant paid out to shareholders in 1911 the very creditable sum of £103,896.

Amongst the companies formed during the last two or three years, and which have already given excellent productive results, the Lonely mine, in the Bubi district, situated to the north of Bulawayo, and a subsidiary of the Rhodesia Gold Mining and Investment Company, calls for special remark. Development here appears to be disclosing quite satisfactory results, and a large tonnage of profitable ore has been blocked out. The company has a thoroughly modern and effective plant, consisting of fifteen stamps and a tube mill, with Pachuca vats, etc., and although this has been running for only a short time, the company has been enabled to declare a dividend on the fairly substantial capital of £271,000.



The Penhalonga Mine

But whilst the Lonely and one or two other flotations which date virtually from the boom times of 1909 have steadily improved their positions, many of the older mines of the country have depreciated in a most striking manner. For instance, the Jumbo, in the Mazoe district, has, it appears, well-nigh reached the end of its tether. The Penhalonga, at Umtali, is not in a satisfactory position, and its absorption by the Rezende, which has been doing somewhat better of late, is counselled. Expectations at the Surprise have failed to materialise, and the property is to be operated on a tributing basis. The Wanderer, the Bush Tick, and the East Gwanda, in Matabeleland, and the Battlefields, in Mashonaland, have been performing indifferently. Furthermore, some

of the newer flotations have proved extremely disappointing. Both the Buck's Reef and the Hay, for instance, after giving brilliant promise in their earlier returns, have fallen off greatly; so much so, that it would seem the former at least of these two mines may at no far distant date have to be erased from the productive list —for a time at any rate.

Two Very Promising Concerns.

Against these disappointments may be set the manner in which two of the most promising mines in Africa are opening up—the Shamva and the Cam and Motor. It has been stated that the Shamva is likely to become one of the largest gold mines of the world, and that the excellent state of affairs at the mine—constantly increasing ore reserves of a steadily improving value—continues to be maintained is shown by the following cable recently despatched by the local to the London office of the company: Ore developed during the quarter ended March 31st, 1912, 283,740 tons, of an average assay value, unreduced, of 13.48 dwts.; reduced, 7.28 dwts. Tonnage at date—2,091,859 tons, of an average unreduced assay value of 8.08 dwts., reduced 4.97 dwts. A stamp battery of Nissen pattern has been ordered, and the mine should commence to record substantial monthly outputs in about twelve months' time.

As to the Cam and Motor, three years ago these very important Eiffel Flats properties were in the possession of small workers, practical men who had to strive and struggle with propositions which they soon realised were



The Cam Mine, Eiffel Flats

far too large for comparatively slender pockets. Towards the end of 1909 the London and Rhodesian Mining and Land Company acquired the properties of the Good Shepherd Syndicate and the Brothers Campion. Flotation of the Cam and Motor Mines resulted about a year later, and there can be no question as to the magnitude of the debt which Rhodesian mining owes to those who first exploited these properties. For the Cam and Motor has proved itself to have all the makings of a really vastly important mine, and during the depression of the past few months the continued excellence of development in this Gatooma proposition has undoubtedly exercised a beneficial and steadying influence on the industry generally. It is now stated that there are "in sight" in the property well over a million tons of ore of a value of fifty-two shillings per ton. It would be well to have more definite particulars of what development has actually been carried out before accepting this statement, but it is clear from recent reports that the tonnage developed to-day is largely in excess of that blocked out at the end of September, 1911, viz.: 700,000 tons of a value of 47s. 2d. per ton. Meanwhile, preparations are being made for the erection of a large reduction and treatment equipment. It has all along been recognised that minor difficulties would probably be encountered in the treatment of the ore, and the directors have pursued as cautious and commendable a policy in this respect as in regard to development. An experimental plant has been at work for some time past, and it is understood that this has already indicated an efficient and profitable method of treatment. Taken on the whole, the management of the Cam and Motor may be said to afford an admirable example of what Rhodesian management should be. The mine is in an exceptionally strong position as regards the ore reserve. Moreover, the nature of the ore will, it appears, be thoroughly understood before any attempt is made to proceed with the erection of permanent plant, and, as all the world knows, it has been a not uncommon fault in Rhodesia to proceed with the premature erection of crushing plant.

In a somewhat lesser degree the results attending the exploitation of the Golden Kopje mine (Lomagundi), the Antelope (to the south-west of Bulawayo), the Eileen Allanah (the important Willoughby Consolidated flotation close to the Cam and Motor), and the Falcon (a large low-grade gold-copper venture in the Blinkwater district) presage the entry of other producers of much importance at an early date. Obviously, the development of these concerns is a most vital matter to Rhodesia. On the manner in which they continue to open up the prosperity of the country for some years to come largely depends, and it is, therefore, especially encouraging at the present to learn that the large tonnages of payable value existing in these mines are being augmented.

The Part of the Small Worker.

Although large numbers of the so-called small mines of Southern Rhodesia, which have earned undying fame for Matabeleland and Mashonaland, are now embraced by the larger corporations and companies of the country, it must not be supposed that the small mine movement—the endeavour on the part of small syndicates, lessees, tributors, and working owners to acquire and operate mining properties at a profit—has appreciably weakened or lost ground during the last year or two. The names of several famous miniature mines, as they were termed, have changed somewhat with a change of ownership. The Eileen Alannah, the Lonely, the Buck's Reef, the Cam and Motor are still known by their familiar and long-established titles, but the "G.M. Co." and "Ltd." figure after them. Such concerns, although now controlled from head offices in Bulawayo, Salisbury, Johannesburg, and London, will for all time be associated with names like Wood, the Campions, and Triggs—hardy pioneers who succeeded where in the first instance the large company failed.

To-day the tributors and lessees are producing about twenty-six per cent. of the gold output of the country. Additional discoveries are being continually made in nearly every district of Matabeleland and Mashonaland, and in the great majority of instances it is the agent of the small syndicate or the prospector on his own account, and not the agents of large corporations, who are making these additions to the known gold deposits of Southern Rhodesia. The last rainy season militated somewhat against prospecting in the fields lying at some distance from the railway, but it would appear

that this winter a number of new and miniature concerns will figure on the tributors' and lessees' lists of producers as a result of the exploratory work carried out during the past few months.

Speaking at the annual meeting of the Rhodesia Chamber of Mines, held in Bulawayo a few weeks ago,



A Shaft on the Eiffel Flats

Mr. George Mitchell, who presided, said the analysis of gold production for the year 1911 was as follows: Companies operating own claims, 1,122,341 tons, 464,859 ozs., £1,960,271, equal to seventy-four per cent. Tributors of companies' claims, 274,734 tons, 77,415 ozs., £325,413, equal to twelve per cent. Small syndicates and individual workers, 206,403 tons, 86,248 ozs., £362,212, or fourteen per cent.

Two New and Important Flotations.

And now, in bringing this review of mining in Southern Rhodesia to a close, a word or two must be said anent two developments which are each of singular importance and which may do much to assist the development of mining enterprise in this wonderfully mineralised territory.

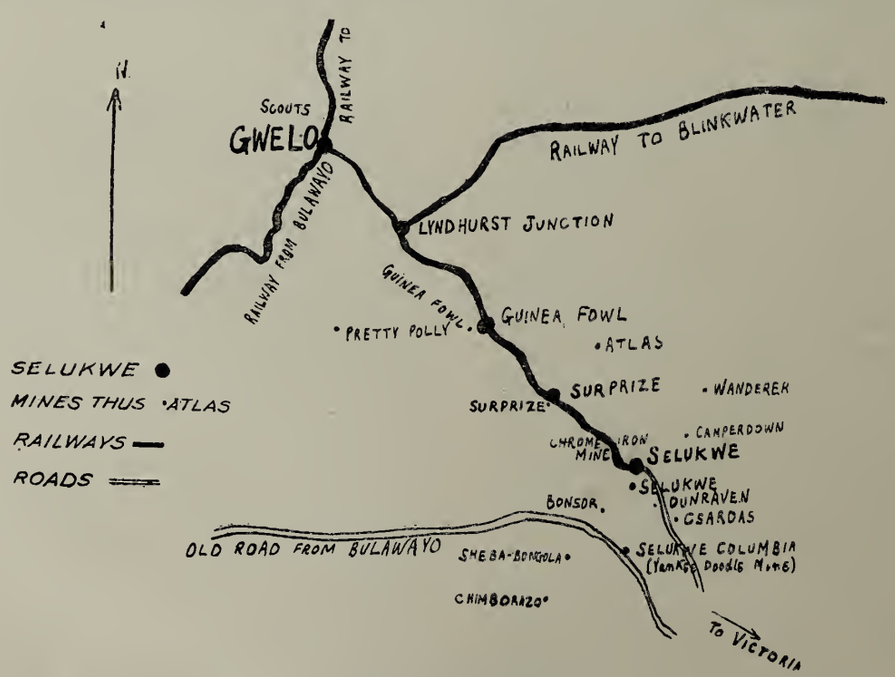
Reference is made to the union of the Consolidated Gold Fields of South Africa and the Rhodesia Exploration and Development Company, and in the second place to the formation of the British South Africa Mines Development Company.

The formation of the Gold Fields Rhodesian Development Company will no doubt give additional tone and strength to Rhodesian mining and the Rhodesian mining market in many ways. The consummation of the amalgamation scheme will be of beneficial influence in hastening development and increasing ore reserves. Such a policy is highly commendable, especially in Rhodesia, where further ore reserves are urgently required. The Gold Fields Rhodesian Development Company has taken the field of Rhodesian mining with a capital of three million pounds sterling. The new flotation ranks second only to the Chartered Company in point of capital, extent of property, and potentiality, and that it will be a vastly important commercial and political factor in South Central Africa admits of not a moment's dispute.

As to the British South Africa Company's Mines Development Company, Ltd., it must be admitted that, whilst this flotation promises greatly to assist the early development of mines and to nourish small ventures, and, if they merit it, bring them to productive maturity, the B.S.A. Company's action has met with wholesale condemnation from the larger companies of the country, who protest that the Chartered Company has created a subsidiary which will compete under exceptionally favourable conditions with existing mining companies. However, although there is no doubt a great deal to be said for the view that the formation of this concern should have been delayed until the administrative and commercial departments of the B.S.A. Company were more clearly divorced, its creation must be chronicled as a noteworthy act of progress.

Finis.

Rhodesia is as yet in its infancy. Vast tracts of territory remain to be explored, and it can hardly be doubted that mineral discoveries of importance will continue to be made for years to come. Disappointments must be expected—they are inevitable even in countries far more established than Matabeleland and Mashonaland. But Charterland has only to set her face steadfastly to the light of progress, and who shall say but that in the fulness of years even the most sanguine of predictions that have been made concerning her shall not materialise? Floreat Rhodesia!



The Selukwe Mining District

Mining in Northern Rhodesia

The Great Zinc and Lead-bearing Kopjes at Broken Hill :: Copper Areas and Their Prospects Occurrences of Gold

A FRESH measure of importance has recently been given to mining in Northern Rhodesia by the promulgation of a mining law for that territory. Hitherto mining companies and prospectors in the mineralised districts of North-Western Rhodesia—or, as it is often called, Barotseland—have had to take the powers that be on trust to a very large extent. Title has been vague and indefinite, and the regulations determining mining have been equally nebulous. A good deal of criticism has been directed against the new mining law, and not without reason, but it is at any rate significant that the Northern Administration has at last recognised the importance of mining in this vast territory to the extent of creating a Mining Department.

In North-Western Rhodesia there are several mineral-bearing areas north of the Kafue River. The most important and interesting of these are the lead-zinc deposits at Broken Hill, three hundred and seventy-five miles north of the Victoria Falls, the Bwana M'Kubwa copper mine on the Congo-Rhodesian border, the Kansanshi copper mine of the Tanganyika Concessions to the north-west of Broken Hill, the copper mines situated in the hook of the Kafue River, and the coal measures of the Luano Valley to the south-east of Broken Hill.

Broken Hill, two thousand and fourteen miles from Capetown, was the immediate objective of the Cape-Congo Railway after the bridging of the Zambesi at the Victoria Falls. Presumably, the metallurgical problem of the Rhodesia Broken Hill mine still awaits a solution, despite the optimistic statements made about the middle of 1910, when the company was reorganised and a subsidiary treatment company was launched. There has, of course, never been any question as to the existence of very large quantities of ore in the mines. Here on a high plateau, at an altitude of about four thousand feet, occur a number of kopjes which have been proved by initial development work to contain very large quantities of mixed lead and zinc ores.

A Complex Problem.

The trouble has always been that the ores are so complex and so intermixed with one another that up to the present all efforts to work the proposition at a profit have proved a failure. There are factors in connection with the Rhodesia Broken Hill mine which encourage one in the hope that eventually a process will be devised which will admit of an economical and efficient separation of the metallic elements, but it cannot be denied that the immediate outlook in regard to Rhodesia Broken Hill metallurgy is not too hopeful. The parcels of ore at first sent to England were of simple composition, the principal mineral shipped being calamine. The quantity of free calamine existing in the mine was, however, soon discovered to be limited, and the shipment of trial parcels of mixed lead and zinc ores was then begun.

The Bradley-Williams Process.

After a great deal of disappointing research work, it was officially announced that the Broken Hill ores were amenable to treatment by what is termed the Bradley-Williams process. A first shipment of forty-four tons of ore was sent to England for experimental treatment. The smelting works experts reported "the process offers more promise for the treatment of this ore than does any other method with which we are acquainted, but its details have not yet been fully worked out." In the Bradley-Williams method the essential principles of the process consist in subjecting a solution of zinc sulphate to electrolysis (thus depositing a small portion of its zinc contents, while acidifying the solution), and then dissolving the zinc out of the ore with this electrolysed solution. The solution is then again electrolysed and the cycle continued. A certain amount of sulphuric acid is consumed by constituents of the ore other than zinc, and thus lost, this loss having to be made good by the addition of fresh acid at intervals.

Another Method.

As a result of these experiments, the Bradley-Williams Company are, it is understood, erecting large treatment works on the Tyne. The final decision with regard to the Bradley-Williams method is subject to satisfactory results being obtained at



Mineral Areas of the Congo and Northern Rhodesia

the new works. The directors have, however, kept a free hand in this matter, and whilst these negotiations were in progress, and afterwards, the management of the company kept in communication



Rhodesia Broken Hill—One of the Mineralised Kopjes

with other important metallurgical firms. One of these firms has reported on samples of the ore as follows: "From the small experiments which were first made on a laboratory scale, by leaching the ore with sulphuric acid, the results obtained were, from an electrical efficiency point of view, so encouraging that a further quantity of ore was supplied. The continued trials did not, from the leaching point of view, yield results so promising as at first, owing to increased leaching difficulties. This factor was found to be so serious that it was necessary to reconsider the whole problem, and to approach the subject of zinc and lead recovery by electric distillation." Owing to pressure of other work, the firm in question have not yet been able to complete these experiments, but hope to be in a position to report more fully at an early date. But whatever method of treatment which may be finally adopted for these ores, it is certain that the cost of the power required will remain a heavy item in the total cost. The possible sources of power are the Victoria Falls, situate at three hundred and seventy-five miles, and the Wankie Colliery, at four hundred and forty-four miles from the mines. They are both on the railway en route to the port of Beira. If from either of these a supply of power can be obtained at a sufficiently low rate, which would still be remunerative to the supplier, a very great advance towards the realisation of the Broken Hill Company's hopes will have been attained. Pending the carrying out of further metallurgical tests, no work of any consequence is being done at the mine at present. There are thousands of tons of ore lying exposed and awaiting further treatment.

The Copper Mines.

On the frontier of the Congo State and North-Western Rhodesia, the Northern Copper Company possesses the Bwana M'Kubwa mine, famous for beautiful specimens of malachite. Engineers have reported the quantity of ore exposed at eighty thousand tons of fourteen per cent. ore, and in addition a large quantity of lower-grade stuff, yet, apart from shaft sinking, little work is being undertaken at present. This mine is a subsidiary of the Rhodesia Copper Company. Bwana M'Kubwa should soon enter the productive list, as a treatment plant has been ordered and should come into operation at an early date. In this locality, too, is the Roan Antelope mine, a property of less importance.

In the hook of the Kafue River there are a number of copper properties under the control of the Kafue Copper Development Company, notably the Silver King, Sable Antelope, Rhino, and Hippo mines. These are situated some distance from the Kafue, and on account of transport difficulties, and also because of the comparatively low grade value of the ore, the mines have never come prominently before the public. They are, however, producing copper from time to time. At one time the construction of a branch line from the Kafue River station to the Beira and Mashonaland Northern Extensions Railway was considered, but the project has never materialised, and the prospects of its doing so are remote. As an alternative, the utilisation of some of the navigable stretches of the river combined with a porterage system along the banks, where rapids occur, has been suggested; this scheme also seems to have fallen out of favour.

The only other mine of importance in North-Western Rhodesia is the Kansanshi, in which the Tanganyika Concessions is largely interested. Given railway communication, this property might soon enter an important productive stage. As yet no such scheme appears to have been mooted, and the property cannot at the present day be regarded as an asset of much value. A little gold has been found near Kasempa in banded ironstone, and toward the end of last year a company was formed to exploit this deposit. North-Western Rhodesia, unlike Southern Rhodesia, appears to be singularly poor in the precious metals.

In the adjacent territory of North-Eastern Rhodesia, a vast and practically untravelled area which extends to Lake Tanganyika, an occurrence of gold in the Luangwa Valley at Sassare has been worked for some years in a small way. The difficulty of transport in connection with this mine has proved enormous; it is



Rhodesia Broken Hill

indeed reported that it took a traction engine two years to reach the property from Tete. Add to this the disconcerting fact that sleeping sickness is sweeping down the valley, and it will be apparent that Sassare is

not a venture of any great promise. Gold occurs here in basement schists which are correlated with the Swaziland schists of the Transvaal.

Another discovery of gold has recently been made on the borders of North-Eastern Rhodesia and Portuguese East Africa at Madjimoio, and a Tremain mill has been ordered for the purpose of testing this property.

The Outlook.

Taken altogether, the prospects of Northern Rhodesia becoming a mineral-producing country of considerable importance are bright, but its development will take much time. In so far as exploitation to date has proceeded, it looks as if the country will be of vastly greater importance as a producer of base metals than of gold. The successful establishment of a base metal industry in Africa north of the Zambesi is, however, as has been demonstrated in the Katanga, a lengthy business, and it is hardly likely that the outputs of Northern Charterland will be sufficiently large or important to attract much notice for some time to come.

RAND MINING IN PICTURE



Early Main Reef Workings, showing Banket Formation

The Great Copper Fields of Katanga

A Region of Wealth and Problems :: Position in the Tanganyika Concessions

FEW base metal properties have evoked so much interest as the great copper areas of the Southern Congo, generally spoken of as "Tanganyika Concessions," or in stock-market phraseology "Tanks." For the present the Katanga mineral belt is under somewhat of a cloud. The ambitious treatment programme has, as was generally anticipated, proved a failure. The smelters have run intermittently, and at the moment of writing are idle. It is clear that the metallurgical programme will have to be remodelled. Further huge sums of money will be necessary for the achievement of this work. Apart from these domestic troubles, the linking-up of Katanga with Lobito Bay is a crying economical necessity. A railway is advancing from the coast to the interior, but its progress is slow, and in any case its completion will be a very expensive matter.

Katanga and the Rand.

Why have not the large South African mining and financial houses taken a hand in the game of developing the Katanga mineral belt? It is indisputable that the quantities of copper existent there are very great indeed, and surprise is often expressed that the big Johannesburg-London groups have not interested themselves in the Katanga region. As a matter of fact, influential Rand firms have despatched mining engineers to the copper fields of the North, and have instituted first-hand enquiries into the value and general prospects of the enterprise. It is rather significant that so far these groups have refrained from interesting themselves in the Katanga, and it is an open secret that this "stand-off" attitude has been the consequence of doubts and fears as to the economic treatment of the ores. The report of the Tanganyika Concessions, recently issued, shows that the latest smelting in the Katanga with European coke cost £41 10s. per ton at the works; with Wankie coke, £26; and with partly Wankie coke, £30. With improved arrangements for washing, the report states, copper can be landed in the European market at a little over £30 per ton. It is to be hoped that this latter anticipation will be materialised; from the figures given above it is evident that the smelting operations to date have been far from satisfactory. However, it by no means follows that because the Rand groups have hitherto eschewed Tanganyika they will continue to do so in the future. Who knows but history may repeat itself, and as the fortunes gained in Kimberley developed the Rand, so may the financial powers of Johannesburg promote the industrial growth of Katanga?

A Vast Cupriferous Belt.

A few years ago these copper mines existed in the minds of most people as "somewhere in the heart of Africa," but that they would become mineral producers of consequence in a short space of time did not enter into the calculations of anybody, except Robert Williams and his colleagues—the men who have been mainly responsible for the exploitation of these copper belts, and for the linking of them up with the ports of South Africa. When it is stated that authorities have declared that these mines are capable of yielding almost unlimited tonnages of ore containing close on thirty per cent. copper, that others have stated that these properties have three hundred million tons of ore in sight, and that as a fact four years ago there were six million tons developed in the properties above tunnel levels, while since then these tonnages have been greatly increased, it will become evident that these mineral deposits are worthy of the very closest attention of mining men, financiers, and the investing public all the world over. It is perhaps hardly necessary to point out that some of the statements circulated regarding these mines are in all probability gross exaggerations. On the other hand, absolutely reliable mining engineers have testified to the magnitude of the deposits and the great productive potentialities of the mines.

About the year 1898 prospecting expeditions discovered large base-metal deposits in Northern Rhodesia. Further exploration led to the location of cupriferous zones on the borders of Northern Rhodesia and the Congo Free State, and also in the Congo early in 1899, and the Zambesia Exploring Company, Ltd., floated the Tanganyika Concessions, Ltd., the company which has been mainly responsible for the development of the Katanga copper region. The nominal capital of this company is at the present time £1,000,000 in £1 shares. Of these, 758,094 are issued and are quoted on the market at £2 15s. The debentures amount to £2,187,864 five per cent. in £8 bonds. The Katanga minerals have been transferred to the great Belgian company, the Union Miniere du Haut-Katanga, in which the holding of the Tanganyika Concessions is now forty-five per cent. The company also holds a two-fifths interest in the Katanga Railway Company, and 2,700,000 shares in the Benguella Railway Company. Other interests of the company are: £178,000 debentures, 500,750 ordinary £1 shares, 44,500 B. 1s. shares (Rhodesia-Katanga Junction Railway* and Mineral Company), and 51,353 £1 fully-paid shares, 19,996 1s. paid shares (North Zambesia Concessions, Ltd.) and £5,000 debentures, Rhodesia Railways, Ltd., mineral concessions over extensive areas in the Congo Free State, as well as the Luano coal areas in North-Western Rhodesia, trading and township rights, etc.

The Katanga Mineral Belt and Its Situation.

The situation of the mineral belt is between latitudes ten and twelve degrees south. The easterly and westerly limits of the belt may be defined as the Star of the Congo mine and the Dikurwe mine, a total distance of about two hundred miles. The altitude of the district is between four thousand and five thousand feet above the sea level, and the country is well wooded and well watered. There are in all more than one hundred mining locations on this copper belt, and of these only about a score have been opened up to any appreciable extent. The geological formation of the country is in the main sandstone and dolomitic limestone. In the hills the beds have been much weathered; much of the dolomite has had its soluble constituents leached out of it, and there remains a cellular quartzite rock, overlying and underlying which are the sandstone beds carrying carbonates and silicates of copper. The average thickness of the cupriferous sandstones throughout the Katanga belt is probably in the neighbourhood of ninety feet. In all probability the ore originally existed in the form of sulphides; was converted into copper carbonate by surface waters, and was then re-deposited in the

* To this company, properties and rights, including the Kansanshi mine were transferred in 1909.

sandstones adjoining the cellular quartzite. Under the direction of the technical advisers to the Tanganyika Concessions and the Union Miniere, numbers of tunnels have been driven into the hillsides, and shallow shafts have been sunk, and crosscuts have been driven from their bottoms. It is impossible to say how much ore has been made actually available for mining by these operations, but it is a certainty that many millions of tons are awaiting removal and treatment, and that a great deal of this ore will yield about nine or ten per cent. metal. In some of the tunnels the width of ore exposed is often enormous. This width is, however, in many instances, more apparent than real, as on account of contortion of the strata most of the tunnels have been driven diagonally across the beds.

Expert Estimates.

Towards the end of 1907, Mr. Frecheville, the eminent English mining engineer, was commissioned to report on the properties of the Tanganyika Concessions, Ltd. His report has never been published; but Mr Robert Williams recently took shareholders into his confidence to the extent of giving calculations as to ore in sight. Three experts have reported upon the different deposits. Estimates of ore proved are as follows :—

		Copper	
KAMBOVE—	Tons of Ore.	%	Total Tons.
Mr. Frecheville ...	1,800,000	12	215,000
Mr. Atherton ...	2,500,000	14	350,000
Mr. Gibb ...	3,000,000	12	360,000
STAR OF THE CONGO—			
Mr. Frecheville ...	435,000	14 & 9	50,000
Mr. Atherton ...	1,500,000	11	165,000
Mr. Gibb ...	1,200,000	15 & 6	106,000
MR. ATHERTON'S OTHER ESTIMATES—			
Fungurume ...	1,500,000	7	112,000
Kwatabala ...	1,150,000	7	85,500
Likasye ...	1,000,000	12	120,000
Kabalela ...	1,000,000	7	75,000
Dikurwe ...	800,000	12	96,000
Musonoi ...	600,000	9½	57,000
Kolwezi ...	450,000	13	60,000
Kakanda ...	350,000	9	30,000

These figures refer only to ore found to exist by the shafts and underground work that has been done. Mr. Frecheville, it will be seen, has made the most conservative report. The discrepancies existing between the different estimates are remarkable.

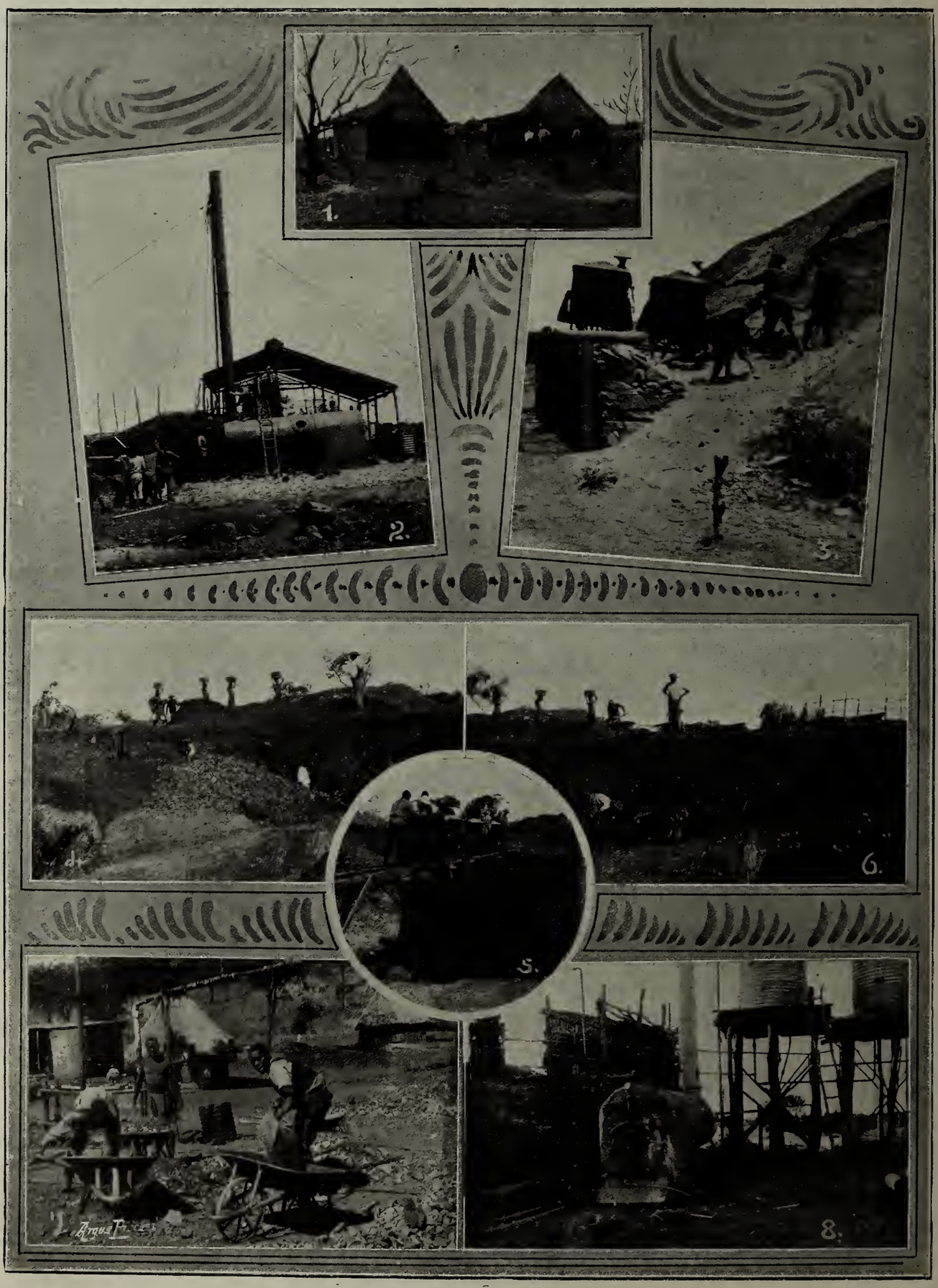
The Question of Metallurgy.

Granted that the quantities of ore existent in the Katanga copper region are so enormous that they cannot at the present moment be estimated with any degree of accuracy, the metallurgical and commercial aspects of the undertaking have next to be considered. On the average, the Katanga cupriferous ores carry about sixty per cent. silica, or about forty per cent. over and above the amount that would be fluxed off by the bases present. It has been an open secret for a long time past that the metallurgy of these deposits presents a difficult problem. The distance from the seaboard, the highly siliceous nature of the ores, the large quantity of flux required and the distance which flux has to be brought, together with the heavy cost of coke, are all factors which combine to make the treatment problem one of unusual complexity and difficulty. The advisability of adopting some wet method of treatment becomes obvious when one takes all the factors set forth in the above into account, but whether there is any leaching method in existence, the success of which has been demonstrated, when working on a large scale, and which is suitable for the conditions obtaining in the Katanga region, is debatable. There seems to be a certain amount of secrecy maintained as to the exact nature of the process adopted at the Star of the Congo, Kambove, and other mines. Very possibly Tanganyika Concessions will be the first mining company to prove the success of a wet process in dealing with an ore containing sixty per cent. silica, and situated under similar conditions to those obtaining at Tanganyika, but that success has yet to be practically demonstrated. It was recently announced that the Rhodesia-Katanga Junction Railway and Mineral Company had discovered an extension of the Kalulu coal fields. It is reported that an additional area of five miles of coal measures has recently been located. This, it need scarcely be said, is of vital importance to the Tanganyika Concessions, although more value would be attached to the statement if it were recorded what the coking qualities of the coal were. For months past prospecting and initial development work has been proceeding, under Tanganyika Concessions Rhodesia-Katanga Junction Railway auspices, in the Luano Valley and Kalulu areas, and it appears that large quantities of coal have been located. But of the coking properties of these coals nothing is at present known, and from the fact that the Tanganyika Company have been for a long while past negotiating with the Wankie Colliery for the supply of coke, it must be inferred that the Luano and Kalulu measures are deficient in those elements of which the Katanga copper fields are greatly in need. The Katanga is on account of its geographical position a region of extreme economic problems and difficulties. No one will detract from its great value or dispute the probability that most of the difficulties will in time be solved. But in the opinion of those competent to judge, the day of solution is still a good long way off.



Views of Government Miners' Training School, Wolhuter

Rhodesian Small Mines



VIEWS ON TYPICAL RHODESIAN SMALL MINES.

1—A Small Worker's Home 2—Erecting Plant 3—Trucking Tailings to the Cyanide Plant 4 & 6—Rubble Pit on the Pickstone Mine, out of which £15 300 worth of gold was recovered 5 & 7—Transporting Ore 8—Plant in Course of Erection

The Rhodesian Smallworker

By R. W. PRINGLE

TO readers on the Rand and other well-established fields, the term smallworker requires a word of explanation. Living and working as they do on a field where exploitation must, on account of the comparative poverty of the ore treated, be on a large scale, involving proportionately large capital expenditure, and where, therefore, it is quite out of the question for the man of enterprise and energy, but small resources, to attempt to work properties himself, the smallworker is all but unknown.

The smallworker, however, is a familiar figure in many other mining centres, notably Mexico, South America, and the western States of America, also, to a certain extent, in Australia and most other mining fields. As a rule, in these countries he is, as it were, a camp follower, working alongside of large concerns and often benefiting by the advantages possessed by his wealthier neighbours. He can obtain freight, and therefore supplies, at a reasonable rate. Repairs can be executed and spare parts obtained without difficulty and at a reasonable cost. In Mexico and America generally the smallworker usually sells his ore to a customs works, where his shipments are sampled, weighed, and assayed, and paid for like merchandise, a small charge being made for treatment and certain deductions for loss. The miner is relieved of all milling troubles: he has merely to mine and raise his ore, rough sort it by hand, and ship it to the nearest customs mill or smelter. His initial outlay on plant is small, and his returns come in with the first pound of ore he ships.

The Rhodesian smallworker has to face a very different set of conditions. He finds himself in a country where, after twenty years of prospecting, comparatively few ore deposits of any great magnitude have been found. On the other hand, a great many small deposits have been discovered, and it is being more and more realised by Rhodesians themselves and by outside investors, that theirs is a country, par excellence, of small concerns, in which individual men or small syndicates have an opportunity, in return for hard work, of obtaining a return for their labour greatly in advance of anything they could expect in old-established fields, where the only opportunity is to work for a salary in mines worked by large concerns prepared to invest large sums of money in return for a comparatively small return for every pound invested.

Many stories can be told of men, or the partnerships of two or three men, who started not so long ago with a few hundred pounds and a determination to overcome difficulties, and can now sign their names to cheques of five figures.

Such an outlook will appeal to many an enterprising spirit on the Rand and elsewhere, and it may therefore not be out of place to very slightly sketch some of the difficulties which have to be overcome and the chance of success to be achieved by anyone who contemplates joining the ranks of the Rhodesian smallworkers.

First there is the question of prospecting. Before doing anything else, a suitable block of ground must be obtained upon which to start operations. If the prospective smallworker is fortunate enough to hear of a tribute and is satisfied that there is a reasonable chance of obtaining payable ore, and if the ground to be tributed is already equipped with a plant, many of his problems will be already more or less solved for him. We will consider, however, the case of the man who desires to possess his own ground. In this case, he must be prepared to devote a considerable amount of time and some money to prospecting.

Now, prospecting in Rhodesia is more difficult than in most countries. The outcrops are, for the most part, covered with a considerable thickness of soil, so that the usual aids to the prospector, found in other countries, such as definite quartz ledges standing up out of the surrounding rocks, porphyry dykes, as in Leadville and Mexico, stained with iron and carrying mineral on their flanks, forming a striking contrast to the grey enclosing limestone, differences due to vegetation, the possibility of tracing float in streams and watercourses, and many other well-known indications followed by the prospector, all these are absent in Rhodesia. The chief guide which the searcher after mineral deposits has had up to now has been what are known as ancient workings. These may consist of anything from actual shafts and open-cuts to mere depressions in the ground, often only a few inches below the general level, and overgrown with bushes so as to make their discovery almost a matter of accident. Having found one or more of these so-called ancient workings, our prospector may be fairly certain that he is in the neighbourhood of a gold-bearing vein.

Assuming that he finds indications of payable ore in the workings or among the dumps of debris and quartz chippings, a considerable amount of work will still be necessary in the way of cleaning out these old workings and probably in trenching to uncover the extension of the vein before the erection of a plant will be justified.

There is, however, in Rhodesia a form of deposit more or less peculiar to the country, known as rubble, from which the Rhodesian worker may obtain sufficient values, at a small cost, to give him a start financially and tide him over the first few months when, as is often the case, it is all expenditure and no returns.

The origin of this class of deposit is still doubtful. It consists of beds, from a few inches thick to several feet, consisting of quartz and other pebbles, usually rounded and worn, and undoubtedly derived from the breaking down of vein outcrops. Unlike most gravel deposits, these do not occur in the valleys and watercourses, but are found as continuous layers of varying thicknesses over large areas, and often up the sides of the hilly ground bounding the valleys or vleis. Associated with these rubble deposits are found the outcrops of veins folded over and lying almost flat;



A "Small Mine" District in Matabeleland

while again there appear to be occasional flat or undulating blanket veins mixed with the rubble but not apparently connected with any definite fissure.

The question of the origin of these deposits is beyond the scope of this article. The rubble is always



The Tribulations of a Tributor—Something Wrong with the Power Plant

near the surface, and can be cheaply quarried and conveyed either in barrows by natives or by oxen in Scotch carts to the mill, where it is easily reduced.

Rubble is usually very patchy in value. The great proportion may just about pay expenses, but the occasional rich patches, and these patches are often very rich, yield a handsome return, and may often enable the smallworker to prosecute his development out of profits, and so convert his property into a mine.

Having satisfied himself that he has sufficient value in his claims to justify the erection of a mill, a number of problems have to be faced. Among these may be cited the supply of labour, both black and white, fuel, water, transport, food for natives and cattle, supply of mine timber, etc. The native labour question here, as in other parts of South Africa, is a constant source of difficulty and worry. Generally speaking, it may be said to be inefficient. The physique of the native is poor, and his intelligence is of a low order. The system by which he comes green to the mine and only works for at the most a year, disorganises the industry, as it means that a boy just leaves when he is becoming useful. The native still looks upon the miner as a convenient stopgap between harvests, or as an asylum for him when drought or other visitation reduces him to starvation. Owing to competition, wages are going up, and at the same time (owing to the standard of living required by the Government) the cost of maintenance is increasing. Wages vary from fifteen shillings to two pounds and, for exceptional jobs, as high as five pounds per month. A labour fee of one shilling per head per month is charged by Government. Food, housing, and medical attendance can be put down at, at least, sixpence per head per day. Owing to the high cost of white labour, the smallworker trains the most intelligent of his natives to do a great many jobs usually performed by white men. Natives are employed as hoistmen, stokers, amalgamators, cyanide shiftmen, blacksmiths, carpenters, and, in some cases, in clerical work. Natives, however, of sufficient intelligence to perform the above duties are not easily obtained.

Fuel.

Wood is the almost universal fuel, but in a few years' time its scarcity will compel workers to introduce less wasteful methods of consumption, such as suction gas plants running upon charcoal, in place of the locomotive type of boiler now in almost universal use. Cordwood can still be had for the cutting, and most smallworkers possess one or more wagons and ox teams to fetch this in and for other purposes.

Water for milling can usually be obtained in sufficient quantities from the mine. There are few made roads, and in the dry season transport of material is by ox-wagon.

Food Question.

Mealie meal is still the staple article of diet for the native, and when the grass gives out at the end of the season, the cattle must also be fed on it. Hay can still be had for the cutting, and should be cut and stacked by the end of April or the middle of May.

White Labour.

The smallworker cannot afford a large staff, but is willing to pay well for the assistance he requires. Although there are many men out of employment in Rhodesia, efficient and reliable labour is scarce. The inefficiency of white labour can be accounted for in many ways. Probably one important factor is that almost every man working for wages has an idea that, given the opportunity, he will start on his own account. He, therefore, regards his employer as a temporary convenience to bridge over the gap, until he can hear of a likely tribute or partnership. Other causes might be mentioned; the fact, however, remains that the smallworker is seriously handicapped by the inefficiency of the help he can obtain. Time and the better class of men now entering the country will doubtless remedy this.

We have now touched lightly on the difficulties which the smallworker must face. We have still to describe the plant with which he recovers his values. Without exception, practically, the smallworker in Rhodesia is dealing with gold, and such are the magnitudes of the properties with which he had to deal that a mine capable of supporting a ten-stamp mill is already outside the sphere of the smallworker's operations. In fact, it may be said that he speaks with somewhat bated breath of a five-stamp mill, and beyond that his imagination does not carry him.

It is in the adoption of means to an end and in the manipulation of the raw material at his command that the small worker has shown his adaptability to circumstances, and his ingenuity in the way of makeshifts. He seldom has anything but the simplest hand tools. The borer and the white ant are busy pulling down what he puts up from the moment he puts a stick in the ground. Sawn timber and sectional iron, such as angles, channels, etc., are beyond the limits of his purse; even galvanised iron must be used sparingly. Anything heavy, like steel tanks, heavy mortar boxes, engines, etc., are almost out of the question owing to the heavy transport charges



On a Rhodesian Small Mine

and the difficulty of handling heavy machinery without appliances. Then the smallworker must walk before he can run. He has no money for elaborate plants, although they may show cheaper costs, low fuel consumption, etc.

The smallworker had to find a type of plant easy to erect, capable of being easily transported, requiring simple foundations, and suitable for the somewhat inexperienced labour available. The Tremain stamp mill, an adaption of the great steam stamps used for crushing copper ore in the Lake Superior district, seem to supply the required article. It is capable of treating about eight tons of quartz or twelve of rubble per twenty-four hours. It is easily erected, easily transported, requires little in the way of foundations, and is cheap in first cost. It is, however, very wasteful in steam consumption, requiring a 12 h.p. boiler almost to itself, and gives poor amalgamation results owing to the difficulty of keeping the plates free from oil. With its many faults, it has, however, laid the foundations of many a small fortune in Rhodesia, at the same time improving the objurgatory vocabulary of its users. Another plant which has proved a boon to the smallworker is the cyanide plant consisting of galvanised iron tanks. These rendered cyaniding possible where steel or wooden tanks would have made the cost prohibitive.

Outfit.

A typical smallworker's outfit would consist of a Tremain mill, a 16 h.p. locomotive boiler for burning wood, a small hoist, boiler feed pump, return water pump, sinking pump for underground, and the usual piping, tools, tanks, etc. His buildings and headgear will be of native timber, preferably some ant and borer-resisting wood, thatched roofs, except the boiler house, which will have an iron roof. If he treats his sands, treatment tanks, two sump tanks, extractor box, circulating pump, and the usual piping, etc.

The Kaffirs are housed in pole and daaga huts with grass roofs, and the white men usually in similar huts. Such a plant can be erected for from £1,000 to



A Miniature Mine near Bulawayo

£1,500. Costs vary so with the particular conditions that they cannot be given.

The Tremain mill has done good service, but the tendency appears to be in favour of a two, three, or five-stamp gravity mill, or possibly one of the new Nissen mills. Suction gas, owing to the scarcity of fuel, will probably take the place of steam to a certain extent, but the Rhodesian smallworker, owing to the inefficient



A Shaft on a Small Mine in Mashonaland

labour he has at his command, is slow to depart from steam, which is simple and which he can handle.

In this article it has only been possible to very slightly sketch the life and prospects of the smallworker. If he would prove successful, he must be prepared to put up with discomfort and lead a strenuous life; he must work hard and not spare himself. He recognises no holidays except when he has made enough "to take a trip home." He has no fixed hours, like a doctor, he is liable to be called up at anytime, night or day, to attend to a sick mill which will not "vuma," or to cure a refractory pump which his dusky lieutenant informs him is "feeley." He has, however, a constant variety of occupation and has no time to fret over the might have beens or to think of anything but his work. He is his own doctor, mine captain, cyanide manager, mill man, sampler, surveyor, secretary, etc., all rolled into one. He probably has one miner and a handyman to help him, or, if he has a partner, one of the men, or both, can be dispensed with. If he works hard and more or less incessantly, he has the satisfaction of taking his bar to the bank and putting it to his own credit instead of some other body's, and of seeing his pile gradually approaching that point when he can more or less relax his efforts and let the heat and burden of the day be borne by others, while he takes up the particular hobby he has always fancied and is now in a position to indulge in. Few countries afford just the same facilities to the man of energy and perseverance, and while it does not offer exceptional opportunities to the highly specialised and technical man, it is the country for the pushing, energetic man with an all-round knowledge of gold mining, and the ability and energy to put that knowledge into practice.

Mining in Zambezia

A Field of Great Antiquity :: Present-day Prospects

ON the evidence of ancient workings, mining operations were carried on in the territories now controlled by the Companhia da Zambezia in the very remote past. There are many intensely interesting legends and traditions concerning this great mineralised belt of country, many of which are undeniably true. It is known, for instance, that the "lost silver mines of Chicoa" were searched for by many early Portuguese expeditions, the leaders of which had conclusive proof of their existence. But they have never been relocated, and Chicoa must go down to history with such hidden Golcondas as the mines of the Incas and the Mexican Monte Christo, Montezuma.

In the middle of the last century, David Livingstone wrote of Tete as being the centre of an important mining area, and under the liberal mining laws of the Zambezia Company it has been established in more modern times that this is a region of considerable promise.

Mining in Northern Portuguese Zambezia has at different times of late years attracted attention, but, mainly, no doubt, on account of the distance of the properties in this district from any really practicable and useful place of export, no important developments have to this date taken place there. A few weeks ago, however, the Gold Fields Rhodesian Development Company despatched an engineer and staff of miners from Bulawayo to two properties situated in the territory of the Companhia da Zambezia. These two ventures are known as the Muende and the Barros. They are held under option by the Rhodesian Mines Trust, Ltd., for which company the Gold Fields Rhodesian Development Company are the local managers. The board of the Rhodesia Mines Trust, Ltd., had hoped to have been in the position to have carried out active development on these properties during the past year, but, owing to the prevailing market depression, decided to restrict operations as much as possible. However, it appears that there now is a likelihood of a certain development policy being carried out almost immediately. The mining districts of Northern Zambezia are of peculiar interest, not only because of the extensive old workings occurring there—workings which indicate very ancient mining—but also because of the productive possibilities of the area.

Severe Transport Disadvantages.

Northern Zambezia has, as already remarked, suffered much in the past because of inaccessibility. Chifumbaze, which is in the heart of this mining district, is a "prazo" station situated about one hundred and sixty miles north of Tete on the Zambesi. The outlet for Tete is the unsatisfactory port of Chinde on the Indian Ocean, and all machinery, stores, etc., have to be carried up the river, which at times is so low that navigation is rendered impossible. Similarly, all exports have to be transported down this uncertain waterway. These disadvantages have very naturally greatly hampered the mineral resources of Northern Zambezia, but no doubt if any really large or valuable mineral deposit were located, means would be found to remedy the position. The projected linking up of the Shire Highlands Railway with the Beira and Mashonaland Railways will, of course, considerably assist the districts lying to the north of the Zambezi River, and more especially those which abut on Portuguese territory.

The Maggie's Luck and Muende Mines.

The geology and general mineral indications of this little-known part of Africa, which the powerful Gold Fields Development Company are now investigating, are of peculiar interest. Probably the best known mining venture in this district is the Maggie's Luck mine. The gold occurs here in quartz in a big zone of contact metamorphism induced by the meeting of two huge granite masses. The vein matter may, in fact, be regarded as an auriferous excess of silica derived from the granite, which in many places assumes a gneissoid development. This occurrence has been exploited in an open-cast quarry about two hundred and twenty-five feet long by seventy-five feet broad. The property has been equipped with a five-stamp Krupp mill (750 lbs.), workshops, stores, etc. But the results secured here have been erratic and somewhat unpromising. We understand that the venture has been idle, or virtually so, for some months past. Muende is a more promising concern, and the Rhodesia Mines Trust Company is, no doubt, well justified in anticipating that good results may be secured thereupon. Surface trenching has proved the gold-bearing formation to have a considerable lateral extent, while high values have been shown—some twenty-five dwts. over the considerable width of fifteen feet at the only point at which the reef has been intersected in a shaft. Muende lies four miles from Chifumbaze, and consists of a large mass of remarkably hard auriferous iron pyrites. It was for some time owned by Obrist and Co.—a Chinde firm—and was also under option to Mr. Weise's Berlin Company. Trenching and "costeaning" have seemed to indicate a total length of the formation along the strike amounting to at least one thousand feet, and there is every appearance of the existence of a much larger stretch of gold-bearing pyrite.

Chifumbaze is evidently the centre of a mining area of great antiquity. On many of the granite boulders scattered along the flanks of the mountain ranges inscriptions and paintings, which are considered by authorities to date from a remote past, have been found, and there are extensive ancient workings scattered all over the country.

Other Occurrences.

Apart from Maggie's Luck and Muende, there are certain other mining properties in this territory which will, no doubt, in the course of time attract attention and capital. For instance, the Chabuino Gold (quartz) Mine, on the North-Eastern Rhodesian-Zambezian frontier, possesses many encouraging features. In the north-eastern part of the territory graphite of good quality has been discovered. Nearer Tete two copper properties have been to some extent developed—the Kakanga and Pandamacuya mines. They are of low-grade character, but may at some time be turned to profitable account. Scheelite (calcium tungstate) has been found at Kakanga. Coal, too, has been found at several places in Zambezia. The mining laws of the territory are liberal, and the climate is not unhealthy. With better transport facilities, this huge district, which was, without doubt, a mining field of paramount importance centuries ago, may again become notable.

The Lonely Reef

A Rhodesian Mine with a Splendid Record and a Very Bright Outlook :: Present Ore Reserves show Half-a-Million Profit

OF Rhodesia's "new mines," the properties that have been opened up during the last five years, none has blossomed out into productive maturity so rapidly and so splendidly as the Lonely Reef. The history of this venture constitutes one of the romances of Rhodesian mining. Five years ago, Messrs. Palca and Aserman were struggling to maintain the property and keep a tiny



The Lonely Mine
Boiler House, Engine House, Smoke Stack and Headgear

stamp battery at work. To-day, the Lonely is one of the leading mining ventures of the country, is paying dividends on a capital of £271,007, and has in its ore reserves an estimated profit in sight of over half a million sterling.

It was on New Year's Day of 1910 that the Lonely was purchased from its original owners and brought under the parental wing of the Rhodesia Gold Mining and Investment Company, or, in other words, the well-known South African house of Messrs. Lewis and Marks. That was an auspicious beginning of a new year both for the Lonely Reef Company and the former owners. It made rich men of the two lucky partners who had pegged the Lonely, and it commenced the history of a company that has set up a Rhodesian record for bringing a flotation with a capital of over quarter of a million sterling to the dividend distributing stage within two years from the date of registration. The Lonely Reef has done this, and is likely to make other records, for there can be no question that the mine is showing up splendidly. The eighth level is opening up wonderfully well, and it may be truly said of the Lonely that, in so far as development work to date has been carried out, the reef becomes more valuable as a greater depth is attained. Each level, in fact, has so far given better results than the level above, and whilst such an Utopian state of affairs cannot be expected to last indefinitely, it is more than satisfactory to learn that at a depth of over nine hundred feet from surface development continues to indicate an increased value as a greater depth is attained.

Some Salient Facts and Figures.

A few facts regarding this splendid property will be of interest. Presented in "tabloid" form, the salient features of the proposition as they stand to-day may be expressed as under: Capital, £325,000 in shares of £1 each, of which 53,993 are in reserve; property, one hundred and eighty-four claims and two water rights; situation, Bubi district, forty miles north-west of Bulawayo; ore reserves, 140,344 tons, value 22.65 dwts., assumed stoping width, 50.58 inches; treatment plant, fifteen stamps, tube mills, Dorr slimes thickener, Pachuca vats, Dehne filter presses; profit (1911), £38,335 16s. 6d.; dividend, £27,100 14s. 0d.; carried forward (December, 1911), £31,300 17s. 7d.

This is clearly a sound, well-organised, and promising mining venture. Despite its infancy, the Lonely has already become one of the leading dividend payers of Matabeleland, for in addition to the distribution for the last year, a further ten per cent. has been paid out, and its distribution was announced by the directors in the following terms: The directors do not recommend the payment of a further dividend for the financial year under review, but an interim dividend of ten per cent. (two shillings per share), free of income tax, will be paid on May 31st next out of the profits for the current year. This dividend will be paid to shareholders registered in the company's books on May 4th next.

The Mine.

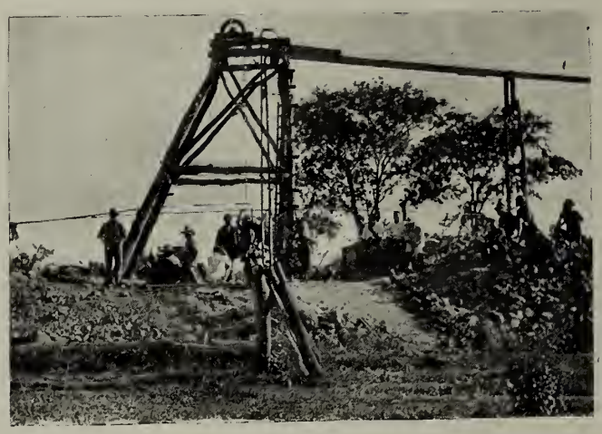
We have already referred to the excellent state of affairs prevailing underground at the Lonely and to the indication that as each new level is driven the ore reserves become more valuable. But as the underground workings are, of course, the essentially important features of any mining venture, and since the Lonely possesses some features of special interest and importance, we will refer to them further.

Mr. Rowsell, the chairman of the company, put the matter in a nutshell at the annual meeting held in May, when he said: Turning now to the mine, I am glad to say that everything we have anticipated with reference



The Lonely Mine General View of Reduction Plant

to the mine has been more than carried out as development work has proceeded. I have no doubt that you will all have read the consulting engineer's report carefully, and I am sure that you cannot fail to have been struck by the remarkable schedule which is to be found under the heading of ore reserves. I call this a remarkable schedule, because it so clearly shows the extraordinary regularity with which the mine has increased in values as depth has been attained. You will see that the increase is quite regular. Above the second level, the value of the ore calculated over a reef width plus twelve inches was 11.30 dwts.; between the second and third levels, 14.33 dwts.; between the third



Mining in the Bubi District

and fourth levels, 18.79 dwts.; between the fourth and fifth levels, 19.62 dwts.; between the fifth and sixth levels, 22.65 dwts.; between the sixth and seventh levels, 30.54 dwts.; and below the seventh level, 34.68 dwts.

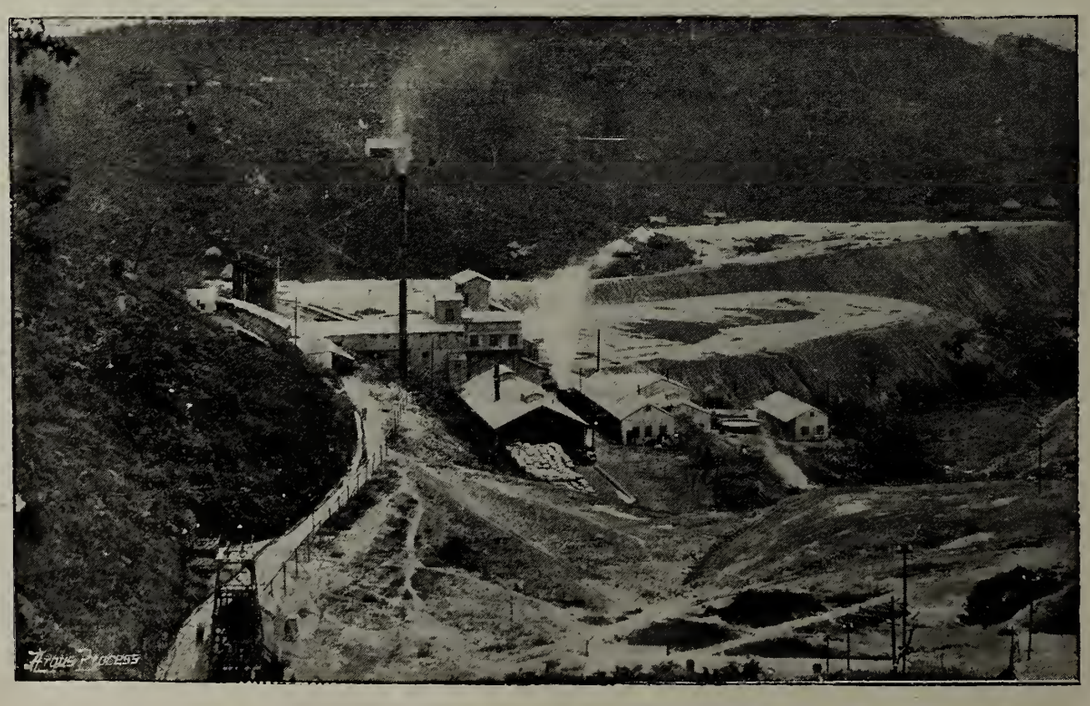
The latest development values which we have on the eighth level, as you will see, exceed two ounces over reef of exceptional width. It seems to me, therefore, that there is reason to believe that the reef in the eighth level will still maintain the record of the Lonely mine in exceeding the values of the level above. This is naturally a condition of affairs which cannot continue indefinitely, but it is extremely satisfactory that at the point which we have now reached, viz., the eighth level, which is at a depth of nine hundred and twenty-five feet, development should continue to point to an increase in value in depth.

Turning to the question of length, the plan which accompanies the report shows very clearly the position, and I am glad to say that the length of the reef over which pay values are found has continued undiminished in depth; and I would remind you that, as pointed out in the consulting engineer's report, in both the sixth and seventh levels the face in the south drive is still in good ore. At the fifth level the net length driven in pay ore was eight hundred and forty-five feet. In the sixth level at the present time the net length is seven hundred and ten feet, but, as I have pointed out, we are still driving in pay ore in the south face, so that there is every reason to expect that at this level the net length of the drive in pay ore will be at least as good as that in the level above. In the seventh level the length of the shoot in pay ore is seven hundred and five feet, while, as I have reminded you, the south face continues in good ore.

Since the annual meeting, development has opened up further valuable stretches of ore, and the latest information available regarding the eighth, or bottom, level states: North drive, 105 to 115 feet; reef width, 42 inches; value, 3 ozs. 17 dwts. South drive, 85 to 100 feet; reef width, 78.6 inches; value, 4 ozs. 8.34 dwts.

A Bright Outlook.

The Lonely is now equipped with three tube mills, and on a basis of four thousand tons per month the ore reserves are quite three years ahead of milling requirements. Working expenses last year averaged just under twenty-eight shillings—a fairly creditable figure considering the initial difficulties in connection with transport, etc., that the management have had to encounter. But these expenses will be reduced considerably as the mine becomes a more established concern. With the prospects of lower costs and the continuance of better values in depth, with ore reserves three years ahead of the mill, and showing a profit getting on for twice the issued capital of the company, and, moreover, with a progressive, yet withal careful, board of management, the future of the Lonely mine cannot but be a bright one.



Wanderer Mine near Selukwe

The Pilgrims Rest and Sabie Gold Fields

A Survey of the Oldest Gold Mining Centre in South Africa

Compiled from Notes supplied by ROBERT SUTHERLAND, Mining Engineer, Pilgrims Rest, (late Asst. General Manager of the Transvaal Gold Mining Estates, Ltd.), and WILLIAM G. F. BARNARD (The Jollie-Bright Gold Mine), Sabie.

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THE gold fields of the Pilgrims Rest mining district are the oldest centre of the gold industry in South Africa. Situated in the dolomite formation of the Eastern Drakensberg, they were the scene of great activity in the early seventies. More than two thousand diggers were actively engaged in wresting a fortune from the rich deposit of the Pilgrims Creek, Mac-Mac, Graskop, and Elandsdrift, which yielded over £1,000,000 worth of gold. The scene has now changed. The Transvaal Gold Mining Estates' concession of three hundred square miles has shut up much of the land that meant often more than a competence, and the possibility of a fortune, is a great apparent lack of knowledge by the general mining world; so that it is the intention of this article to put before the readers of this number facts that are irrefutable—statistics of recent date—to show justification for the claim of these fields to be the oldest and the most active of any gold fields in South Africa.

Though they hold the record in point of antiquity (in so far as exploitation by Europeans is concerned), they are, as yet, in their infancy. Experts who are resident in these fields, or who have visited them from time to time, for shorter or longer periods, are unanimous in the expression of confidence in them. However, as facts speak louder than mere verbosities,



Wanderers South.

to the individual digger. The available ground, however, is the scene of great activity now, unrivalled in any other part of South Africa, over a like tract of country. Rhodesia, with its oft-boomed gold industry, can show no district equal to it, unless, perhaps, the Gatooma district, in number of mines, or aggregate returns. Gradually, as more land is proclaimed, capital is coming in from other hives of industry. The Rand men, looking for an outlet for their capital, are turning their eyes to these rich fields. The rich ostrich farmer of the Cape, having amassed a fortune, finds a change of occupation and a good investment for his capital here in these fields. Almost every month records a find of value or the erection of crushing machinery, yet, withal, there it is not our intention to take up more space, but to proceed at once to a general description of the district and its ore bodies, and a practical survey of the mines at work.

General Physical Characteristics.

The area we deal with is roughly two thousand six hundred square miles, lying north of the Nelspruit-Waterval Onder section of the Delagoa line, and stretching in a narrow belt northwards to the Olifants River. With several exceptions, the rocks are those of the Transvaal system, showing a high degree of complexity. The formations are thus classified by Hall in his geological memoirs: The Pretoria, Dolomite, and Black Reef series.

The dolomite formation is the centre of activity, lying directly on an inclined platform of quartzites and sandstones of the Black Reef series (see p. 197).

There are at least fourteen separate interbedded gold-bearing quartz reefs as well as, in addition, some five vertical reefs in contact with diabase dykes, all of which are responsible for more or less successful ventures. It is worthy of note that no distinct failure can be traced to the lack of values, but rather to the means employed in the working of the mines. The dolomite formation contains the best propositions, on the whole, and is most worthy the attention of the new man. There are, however, propositions found elsewhere, as instanced in the properties on the shales, sandstones, and older granite properties, at Sunlight and Rietfontein, that are worthy of the attention of the capitalist. Farms are being proclaimed at frequent intervals, and the older prospectors are usually aware of good, sound speculations awaiting the man who has money to invest.

We purpose to deal individually with the principal properties of the district, and as this article is primarily dealing with the small man's propositions, we shall pass over the two greater properties here, viz., the Transvaal Gold Mining Estates and the Glynn's Lydenburg, for both of these are too well known; further, it is the object of this article to show the small man that there is here in this district ample scope for his energies and capital, so we will proceed to deal with the smaller mines, which do so much to swell the monthly output in ever-increasing numbers, dividing these into two groups, those in the proximity of Pilgrims Rest and those around Sabie.



The R. Burnham Syndicate.

THE PILGRIMS REST DISTRICT.

Shales Series.

In reviewing an individual section of these gold fields, it is advisable not to deal with a number of mines, but to concentrate our attention on several working propositions of some standing, in detail, and take one of each at work on the various more important reefs to be found here, so as to show clearly that every individual reef is worthy of further attention.

The Shale Reef.

To begin, therefore, with the uppermost reefs, we find the

R. Burnham Syndicate

at work on the shale reefs lying on the ridge of the hills above the Pilgrims Creek to the east and about three and a half miles east of Pilgrims Rest. The ground now worked by Messrs. Burnham and Munro was formerly worked by the old Graskop Company, but was allowed to lapse. In 1906, Mr. R. Burnham pegged the claims, now the richest little mine in the district, averaging as it did last year a monthly output of £2,330 of the ten months worked. The workings lie right on top of the hill above the battery, the ore being removed by open casting. Previously, driving had been carried out, but owing to the soft nature of the overburden, each rainy season saw a collapse of the drives. It was, therefore, deemed expedient to open cast, or quarry, the ore. The reef is very patchy, but values are high all through, a consistent value of £4 per ton milled being obtained. At the time of writing there is some twelve months' ore in sight, and no one can state with any certainty what is hidden further in the hill top. The ore is conveyed by aerial gear from the open cast to the tramline head, whence it descends by gravitation to the mill. The mill is a five-stamp gravity, driven by a 20 b.h.p. Dudbridge gas engine, recently installed by Messrs. T. Begbie and Co., Middelburg, a full description of which appeared in the "Pilgrims and Sabie News" of the 19th April. The engine also drives the motor supplying electric light to the plant, house, etc.

The ore lends itself to an easy mode of treatment, giving little trouble at any stage. The slimes process is a form of the well-known Usher method. The grand total for last year, March to March, was £20,330, which includes April and May, when the mill was closed down, and only a week's run in March of this year. This, from an average of five hundred tons crushed per month, is something to be proud of.

At two levels below the shales adits are being driven in to locate the Theta Reef. At the lower depth the adit has brought to light gold-bearing stringers, and by this time no doubt the reef has been struck.

This syndicate holds valuable interests at Ledouphine in the C.B.M. (Cornwall, Burnham, and Munro) Syndicate, and has just purchased a plant, which it is expected will be erected and in running order by July of this year. This is looked upon as one of the real, live syndicates of the district, for they have proved themselves. They hold valuable farms both in the High and Low Veld, and go in for cattle breeding on a fair scale. Theirs is the premier property on the shales, but besides we have the Little Octopus, another good little five-stamp proposition, on the other side of the hill. Adjoining this and the Burnham Syndicate is Taylor's ground, where shales are proved to be carrying well, and where it is intended to erect a battery shortly.

Away over the northern side of Pilgrims Rest we have the New Lisbon-Berlyn, Limited, the owners of which, according to their annual report, had 60,000 tons of Bevitt's (north) shales, of 10.5 dwts., and 2,000 of Bevitt's (central), of a value of 8 dwts., in reserve last September.

The shale reefs are to be found throughout nearly the whole of the district, thus offering a good field for outlay of capital.

The Theta Reef.

Turning from a consideration of the shales, we come to that series of reefs in the upper dolomite formation, the most important of which is the Theta Reef. This

is the highest geologically, and bears a most important part in the industry here. All, or practically all, of the central mines of the Transvaal Gold Mining Estates are at work on Theta. We say that advisedly, for we fancy the new developments at Columbia Hill are in the shales.

The property we propose to deal with here is the

Wanderers South.

This is situated also on Graskop No. 27, and has an area of two hundred and sixty-eight claims on the Theta Reef. A portion of this mine was in pre-war days worked by the Graskop Company, but work was stopped on the outbreak of hostilities. On the proclamation of the farm, the major portion of the ground was pegged by Messrs. J. E. Anderson and M. J. Wilson, who also, about twelve months ago, took over the property of the Grampian Mines, Ltd. Crushing operations commenced in June, 1911, but, owing to lack of labour, it was found impossible to keep the mill going full time. The reef was struck by the old company, just at the outbreak of the war, in a drive about eight hundred yards to the north of the present workings, and this drive is now being re-opened by the syndicate. The reef is sixteen inches thick, averages 18 dwts., and is consistent. At least 80 per cent. of the claims are gold-bearing, so that with the present plant, a five-stamp, capable of crushing only six hundred tons per month, the prospects are very bright. The ore in sight is estimated at two thousand tons, but, owing to cost of maintenance, it is never considered advisable to develop too far ahead. Labour is now plentiful, and many improvements have been made in the plant of late.

To give some statistics, however, for this is what the prospective capitalist wants, we may mention the following, as showing the tonnage milled, running time, and value of gold recovered :—

	Days Run	Value
June, 1911, 242 tons (old waste and dump) 5 stamps ...	10½ days	£267 8 5
July, 244 tons, 5 stamps	9 days, 8 hours	579 5 0
August, 326 ,, 5 ,,	13 ,, 10 ,,	824 19 7
September, 250 ,, 5 ,,	10 ,, 6 ,,	808 18 10
October, 254 ,, 5 ,,	10 ,, 4 ,,	753 13 2
November, 340 ,, 5 ,,	13 ,, 3 ,,	1,291 12 9
December, 330 ,, 5 ,,	13 ,, 0 ,,	1,038 19 6
Jan., 1912, 218 ,, 5 ,,	9 ,, 13 ,,	673 18 2
February, 233 ,, 4 ,,	11 ,, 8 ,,	702 15 1
2,437		£6,941 10 6

Deducting June, this shows the average grade to be 60s. 6d. Such a total, on an average run of little over ten days a month, is no mean one, and is a good example of a small property at work here. With more facilities for treatment, we hope to see the output almost trebled.

The late Desiré Gold Mining Syndicate, another five-stamp proposition, whose ground was held on tribute from the Transvaal Gold Mining Estates, showed an output for the ten months, January 1st to October 31st, 1911, of £14,570 7s. 9d. At the end of that period the owners of the ground, the Transvaal Gold Mining Estates, withdrew their tribute, and the syndicate dissolved.

In addition, we find in the Pilgrims Creek, on the side opposite to the Little Octopus, Desiré, etc., the Wanderers North, the Pilgrims Creek Gold Mining Company, Ltd., and the Welcome Mine, all on Theta. The last-named has just started crushing, and is a splendid proposition, a 20 dwt. recovery being gained even at the outset.

The giant chert boulders, which are the indication of the Theta, are to be seen everywhere, thus giving another splendid field for careful and painstaking prospecting.

Glynn's Reef.

We now come to the reef, so well-known at Sabie, and named after that stalwart pioneer and squire of Sabie, Mr. H. T. Glynn. This is best exampled in the

Mac-Mac Syndicate.

at work on the adjoining farm to Graskop, that of Geelhoutboom No. 220. This farm was acquired by the brothers MacLachlan, later falling to Mr. Frank MacLachlan, who sold it to the present syndicate. Previous to their taking over, the Anglo-French had done some considerable work, but had abandoned their workings. The reef now being worked was discovered almost three years ago by Mr. Frank MacLachlan. It is generally correlated to the Glynn's Lydenburg and Glynn's Extension, and to the Transvaal Gold Mining Estates on Elandsdrift and Vaalhoek. Its formation is a strong, well mineralised body of quartz, overlain by a decomposed diorite sheet having a footwall of decomposed dolomite. The interlying reef shows a number of quartzose layers with brown limonite divisions. It is usually opaque white in character, with countless cavities caused by the oxidising of the iron pyrites. It is lined considerably with earthy iron ore. The main base of operations is that known as the Saddle. This, last July, gave reef of about 400 feet by 200 feet, giving some 7,000 to 10,000 tons of ore of about 14 dwts. This has opened up to much better advantage, and instead of a year's life, it is hoped to prolong the productive period considerably. Open casting is here resorted to, as at Burnham and Munro's, owing to the treacherous nature of the overburden. There are also some 20,000 tons of ore in sight in the workings abandoned by the Anglo-French, going about 7½ dwts., as yet untouched.



The Mali Dyke (Graskop).

The output from the Saddle workings is as follows:

September	...	...	£752 16 11
October ...	...	...	564 0 10
November	...	...	896 10 8
December	...	...	838 13 8
January ...	...	...	474 15 10
February	...	...	654 2 2
March ...	...	...	950 0 0
			£5,131 0 1

This is the result without slimes, as the plant has only just been erected. It is estimated that there are some two thousand tons of silmes, going 5 dwts., now to be treated. To the north, a mile of reef has been opened up above the manager's house, going 6 to 25 dwts., and this area is being actively opened up. Beyond the old house, to the east, the hill is honeycombed with workings to find the lode from which came the rich alluvial, that gave the diggers so rich a haul just here. The wash still carries well, and is being traced upwards. At some two hundred feet below the Pretoria shales, Theta has been struck, but nothing better than 8 dwts. has yet been opened up. This strike, though, is very important as showing the continuity of the Theta Reef from Stanley Bush (Wanderers South) to Sabie. A five-stamp mill, driven by a Pelton, is the reducer, with a complete cyanide and slimes plant.

The Sabie sandstones can be followed for a long distance and carry gold. There are two vertical reefs, proved by the diggers before the farm was closed, and it is probable that one of these will be proved to be correlative with Mali dyke. There is an abundant supply of water, and every hope for a long and fruitful life on this property, given a sufficient sum is spent on development. Apart from the mining prospects, the syndicate hope to plant a large number of wattle trees at an early date. The slopes of the Berg, too, are carrying many thousands of loads of valuable mining timber. In fact, it is estimated roughly at three to four thousand loads, and one of the finest forests within a like radius of the Rand. The railway survey pegs cross the farm, so that the syndicate may look for a reduction of working costs in the near future.

Conclusion.

From this brief survey, it will be seen that this district is worthy of more attention. The railway, Nelspruit-Graskop section, is in course of construction, and this year should see it in Sabie as an accomplished fact. From there to Graskop is only a short run of twelve to fifteen miles by the surveyed line, so that even at that stage many men whose time is more or less occupied can easily run down to see the possibilities of the district for themselves.

There is, besides, that immense area of dolomite and Black Reef series lying beyond the edge of the Drakensberg, which has practically not been touched by the prospectors. An expert geologist and prospector down there lately brought back an excellent report, and as several of the more important syndicates hold farms in the vicinity, there is every prospect of active work being undertaken before long.

The lower sandstones, too, have great possibilities, so that it is impossible to gauge the future of these fields.

Now that the right type of man—the small man with capital behind him—is getting firmly established, there is a splendid prospect of these fields becoming more and more important. The cheering point is that no attempt has been made to boom these fields, and men have only to visit the district to see real work actually being carried out on every side. An example of what has been done is shown by the Oudtshoorn capital represented at Mac-Mac, Pilgrims Creek, and The Welcome, all of which hold other claims in the district besides those mines owned by them which are actually crushing or about to crush.

A case of splendid specimens from these fields was sent down to the Colony recently, and will doubtless attract other capital. It is characteristic of the reefs, however, that little visible gold is found. Apart from its splendid outlook as a mining centre, this district is an ideal holiday resort within easy distance of Johannesburg. The scenery is unrivalled in South Africa. Rugged mountains, deep, thickly wooded gorges, and splendid waterfalls abound on every side, and the whole country closely resembles that round Lucerne in Switzerland. The Blyde River Cañon holds one entranced as one gazes far down the great gorge to the Blyde River some two thousand feet below. The view from the Devil's Window, right away for over a hundred miles across the Low Veld below, lingers long in the minds of those whose privilege it has been to view such a gorgeous sight. The country is that made famous by "Jock o' the Bushveld," and those visitors who have paid us visits here are loud in its praise. A well-known mountaineer, who was here recently, has placed on record an account of his visit, as did General Smuts at an earlier date. It will be seen, therefore, that the new township to be declared on Graskop, in a central position to the whole district, has every justification for looking forward to a bright and very prosperous future.

Activity on the Sandstone Reef

A Review of Recent Progress in the Sabie District

THE above name is that applied to the horizontal reef which has been actively worked at Sabie and the vicinity for the last three years. The name is derived from the fact that the reef lies interbedded in the quartzitic sandstone of the Black Reef series.

Starting from the point where the small and large Sabie Rivers meet, the junction of the dolomitic and Black Reef series is plainly defined and can be traced for miles to the north, but so far—with the exception of some workings on Lisbon-Berlyn, twenty-five miles to the north—no serious attempts have been made to locate or exploit the sandstone reef elsewhere than at Sabie, a fact to be wondered at considering the success which has followed the endeavours of the local ventures, also the good working facilities and cheap cost of mining which are features accompanying the working of this reef.

The first successful gold ventures in the Sabie district were on the rich gold leaders at Spitzkop; then came the operations of Glynn's Reef, which, till the working of the sandstone reef, provided practically the sole

successful gold-producing area. It was in 1895, or thereabouts, that attention was first paid to the sandstone formation. At that period Messrs. H. T. Glynn and R. R. Hollins prospected Waterval South—the farm to the north of the Sabie River—but the sandstone reef was not considered payable by the mining engineers who were sent up by Rand capitalists to report. Practically nothing was done on this farm until 1908, when a Mr. Lester pegged a few claims, which is now a portion of the ground owned by the Rex Gold Mine, Ltd. Messrs. W. MacLachlan and Bright took over Mr. Lester's property and acquired many additional claims. A small mill disclosed such excellent results that a rush took place, with the result that within forty-eight hours practically all the ground available for pegging on Waterval South was secured by various owners. Development was started everywhere, and in a short while several mills were erected and crushing took place, as will be shown.

Conberis Syndicate No. 1.

In the partnership mentioned above, Mr. Bright sold out, the two owners being Messrs. H. T. Glynn and W. MacLachlan. They milled for about six months, never securing less than £400 per month from 250 tons, which was the output of their light mill. This property was then sold to the company now known as the Rex Gold Mine, Ltd.

The Rex Gold Mines, Ltd.

This company took over claims owned by Messrs. Lester and Terry, together with a battery erected by them. Other additional claims were purchased by this company, which now owns nearly three hundred. With the five-stamp light mill, about £9,000 was produced in nine months from approximately four thousand tons. A new ten-stamp mill was then erected, and we understand that, considering the small amount of development, the results have proved quite satisfactory to warrant large expenditure in future development. To concentrate work in this direction, the mill was closed down at the end of April.

Conberis Syndicate No. 2.

We now leave the west bank of the Little Sabie River and cross over to the other side and find the first block of claims belonging to the above syndicate, controlled by Mr. W. MacLachlan. The outcrop adits and stopes produced excellent results, but latterly, owing to faults in the reef, the returns have considerably diminished, but with more knowledge, to be obtained by further development, a return to the pristine satisfactory condition will doubtless ensue. A large portion of ground is held on what is known as the Buchanan strike, and when this is tapped (which will occur shortly) similar returns to those enjoyed by the Buchanan and Jollie-Bright Syndicates are sure to be obtained. Since the Conberis No. 2 started crushing in April, 1910, over £15,000 has been produced.

Mr. P. J. Denyssen's property comes next. In similar formation to that of the Conberis Syndicate, Mr. Denyssen has enjoyed many excellent outputs, details of which are not to hand, but of late returns have fallen short of what may be called satisfactory, and until the hinterland of these claims are properly developed, Mr. Denyssen is crushing the quartz obtained from a neighbouring owner's claims.

The Jollie-Bright Syndicate.

Originally held by Mr. Bright, who in the short space of four months produced £3,000 of gold from one thousand five hundred tons, until the flood of January, 1909, washed away his reduction works on the banks of the small Sabie River. Messrs. Jollie and Bright then entered into partnership, Mr. Bright selling out to Mr. Anderson in November, 1909. Electric power was then installed as motive power and a fine plant erected at the mine itself. From September, 1909, to date this syndicate has produced £16,000 from fourteen thousand tons, the cost of production working out at 12s. 6d. per ton.

The Buchanan Gold Mining Syndicate.

Comprises sixty-four claims on the border of North and South Waterval. Mr. R. Buchanan has been long resident in the district, and was one of the earliest and prime actors in the sandstone reef. It is principally due to the success of the Buchanan Syndicate's endeavours that the Ceylon-Lydenburg Company was induced to prospect the ground on Waterval North, which has led to the erection of a five-stamp mill, etc. The Buchanan Syndicate commenced crushing in October, 1910, and since that date have milled approximately nine thousand tons, value £16,000.

The Ceylon Lydenburg Company.

This is the next sandstone reef property to the north. Owing to the highly payable values obtained on the neighbouring properties, this company was induced to prospect their adjoining ground on Waterval North. Prospecting operations during 1910 and 1911 proved the reef over a considerable area, and a reduction plant was erected and milling commenced in March, 1912, since which date some one thousand five hundred tons have been crushed of the approximate value of £6,000.

The only other sandstone property at present conducting crushing operations is that of the Betty Langriff Syndicate, situated on the south side of the Big Sabie River. Milling has been conducted continuously since September, 1909, but information regarding outputs and values is not available.

In conclusion, the operations on the sandstone reef give employment to over thirty whites and seven hundred natives, and so far as can be seen will continue to do so. It is, anyhow, certain that the success of the sandstone reef has given a great impetus to the progress of the district and contributed largely in inducing the Government to build the railway from Nelspruit to Sabie, which will shortly be an accomplished fact.

The Rietfontein Gold Mining Company have during the last two years pursued energetic tactics regarding the development of what is termed the Riefontein Reef, which lies on both sides of the main Sabie River on the farm Rietfontein. That this vertical reef is considered payable is evidenced by the erection, which is now taking place, of two Nissen stamps.

The Hangregyl Syndicate's property is on the Rietfontein Reef, but on the south side of the main Sabie River. Crushing operations have just commenced in earnest, and it is understood a good future is in store.

RAND MINING IN PICTURE



Turf Mines Shaft, Village Deep Gold Mining Company

The Zaaiplaats Tin Mines

By GEORGE H. FURNER
(Consulting Engineer to Zaaiplaats Tin Mining Company, Limited)

THE Zaaiplaats tin mine is situated in the district of Waterberg, about twenty-three miles north-west of Potgietersrust, from which town—which is a small and very scattered one—you drive through the fertile and picturesque valley of the Magalakwin River, over a road which is kept in good repair by the Government. As you approach the mine, the scenery becomes very beautiful, the high granite ridges, with the sandstone



The Mill and Dressing Plant.

range of the Waterberg series in the distance, being special features.

Discovered in 1906 by Messrs. Maggs and Munro, who obtained a discovery right on the 16th January, 1907, the mine was for some time worked in a primitive manner. The richer ore was extracted and shipped to Liverpool, altogether nine hundred and thirty-one tons of crude ore, containing thirty-nine per cent. of tin and one hundred and seventy-six tons of concentrates, containing seventy three and a third per cent. tin, the latter being obtained by a primitive method of concentration.

In 1908, the owners formed a company with a capital of £60,000, the working capital of £20,000 being subscribed by a few capitalists, foremost among whom was Sir Thomas K. Murray, and a thoroughly up-to-date ten-stamp mill and concentration plant were erected. Milling commenced on the 8th February, 1909, and the original stamps, which were light ones, have since been substituted by fifteen-hundred pound ones, and a further five heavy-head erected, making fifteen in all. The plant has been correspondingly increased and a calcination equipment erected, and these with the completion of the second treatment slimes tables, etc., will form a complete installation second to none in South Africa. An electric station and compressor plant supplies all the power necessary for this and the mine work, and all the machinery is motor driven. Altogether there is four hundred and fifty brake horse-power in continuous use, which is ample for present requirements.

A short description of the ore deposits may be of interest. Taking a section of the country from the Magalakwin to the Sterk River, a distance of about eight to ten miles, we have first the basic igneous rocks of the norite horizon with the immediately overlying mountainous ridges of the red Bushveld granite. It is in the coarse-grained granite that the pipes are found, underlying a sheet of pegmatite which has been traced for several miles through the farms Groenvlei, Zaaiplaats, Roodepoort, Groenfontein, and Solomon's Temple, the general dip being towards the west. The overlying zone is of a finer-grained granite, which is succeeded by the felsites, and then by the sandstones of the Lower Waterberg series.

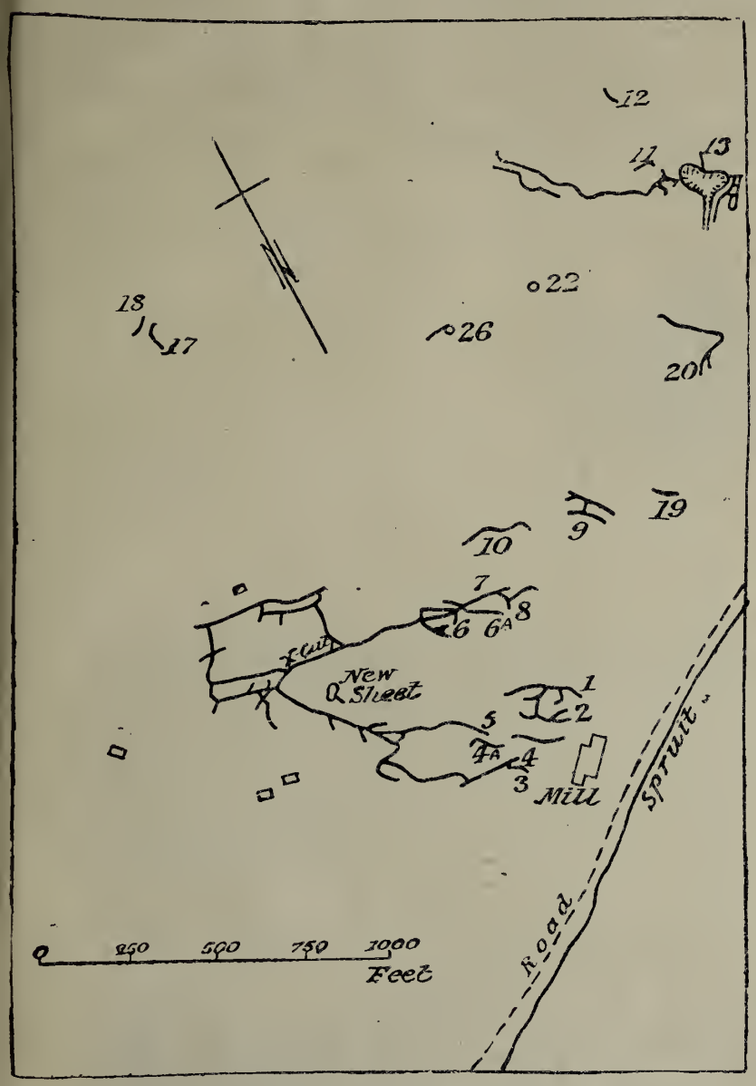
No tin has been found in the formation immediately overlying the pegmatite, but some distance away on the farm Welgevonden No. 777, a fissuring has been opened up, the gangue being sericite intermingled with quartz. This is in the felsite close to the contact of the Lower Waterberg series, and some low-grade values have been found. In the vicinity, stringers of quartzite have also been found carrying tin, but in unpayable quantities. The tin belt proper has so far been only partially prospected, and no doubt when active development takes place some very good things will be opened up. The Zaaiplaats deposits are cylindrical in shape, and



Part of the Camp.

sometimes are grouped together, joining the one with the other and increasing in size as depth is attained. The filling of these pipes is cassiterite, tourmaline, sericite, fluorspar, quartz, calcite, and red felspar, and they also contain at times some sulphide (iron and copper pyrites

and arsenic); antimony, galena, zinc blende, and molybdenite are occasionally met with. The pipes have each their own peculiar individual features, but there does not appear to be any set rule as to their general behaviour at depth. They are sometimes influenced in their course by lines of fissuring and faults, and in crossing these mineralisation is often led along them for some distance, but so far I have not seen enough evidence underground to justify the view that the pipes owe their origin at a greater depth to fissures.



Plan of Zaaiplaats Claims showing the various pipes.

Owing to these ore bodies constantly changing their dip and direction, it makes the work of following them very difficult, but, at the same time, it is a most interesting experience. Mining is now being carried on at a vertical depth of five hundred and thirty feet, the principal workings being Nos. 5, 6, and 13, the premier ore body, No. 13, having already produced over £200,000 worth of tin ore. Some of the pipes, which are on a sinuous course, have been followed down on the incline for some thirteen hundred feet.



Side of Hill looking towards No. 13.
The X denotes where the new ore body on the Roodepoort Lease has been opened up.

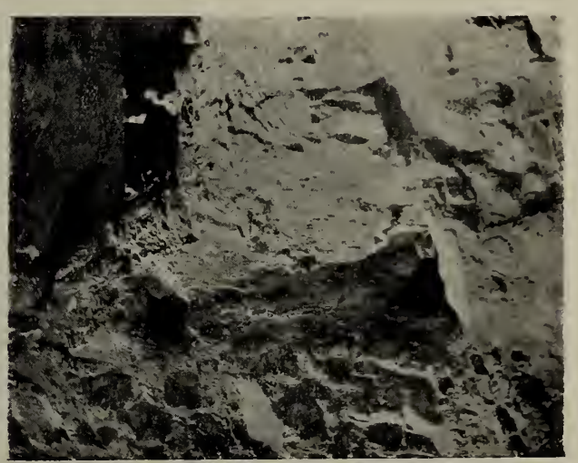
Hauling from the mine is done by a series of air hoists, but the old No. 6 workings have recently been straightened, and an electric hoist will shortly be laid down. The whole of the ore will then be drawn from Nos. 5 and 6 sections through this shaft, and with the elimination of stage winding material economy will be effected.

None of the main ore bodies have yet been found to "peter out," but show as much signs of continuity as ever. At times they come in with extraordinary bursts of richness, and on the whole the concentrates produced have been of high grade. Recent development on the new lease section is most encouraging, and what at present promises to be one of the best producers in the district has lately been opened up.



No. 13, Open-cast Workings.

Water is supplied from the Sterk River, through six-inch steel Mannesmann tubes, a distance of four and a half miles, and against a head of seven hundred and fifty feet. The pumping plants are in duplicate. The rainfall in the district has been the lowest recorded for many years past, only 10.04 inches having fallen during the past six months, resulting in the drying up of streams to a large extent. The Sterk River, however, is still running, so that with the return water conserved below the mine, there is ample water for our requirements.

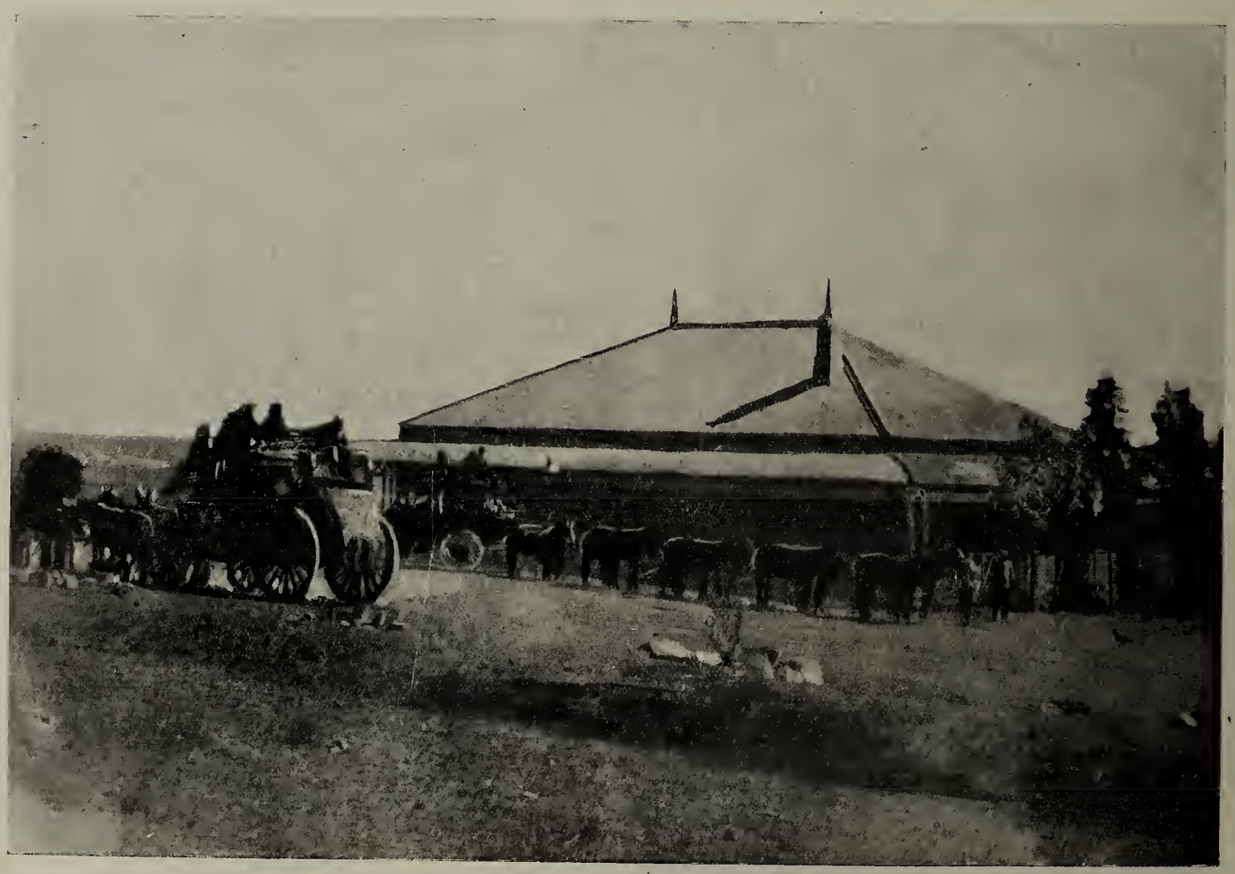


No. 13, Open-cast Workings.—Another View.

A very satisfactory feature in the working of the mine is the adequate supply of native labour, which is obtained from the Zoutpansberg and Waterberg districts. Although rather scarce at first, the supply has, on the whole, been equal to the requirements. This not being a labour district, and as the company do not own any farms from which they could draw their labour, the

mine is dependent on a voluntary supply from outside. The boys had to be attracted to the mine, and are being drawn from as many tribes as possible in the districts mentioned, mainly with the object (1) to secure a continuous and regular supply without incurring recruiting expenses and increasing cost of labour generally, and (2) to secure discipline and orderliness in compound, each section being under the control of its respective headman. The native tribes of the Zoutpansberg and Waterberg are mixed, and the following are the chief families: Amandebele, Basuto, Bavenda, and Shangaans.

Since the incorporation of the company, £73,050 has been spent on capital account. Of this amount £53,050 has come out of profits earned. Altogether there have been 4,354 long tons of concentrates, which realised £450,758 19s. 5d., produced, which, with what crude ore and concentrates were shipped prior to flotation, represent a sum equalling nearly half a million as having been taken out of the mine. Ten dividends have been paid, in all three hundred and ninety per cent., and regular profits of £10,000 per month are being made. The total development risen, driven, and sunk has been thirteen thousand three hundred and sixty feet. Owing to the peculiar nature of the ore deposits, it is impossible to estimate the life of the mine, but with the satisfactory development recently, and the fact that a further large area awaits development, one is justified in taking the view that the life of the property may be a long and prosperous one.



Half-way House on the Pretoria Road in 1892.—Coaches Meeting.

Mining and Ore Treatment at Tsumeb in German S.W. Africa

How the Many Perplexing Problems Presented by the Mining and Treatment of the Ores were solved

By P. A. WAGNER, D.Eng., B.Sc., M.E.

WHILE the Tsumeb Mine can hardly be claimed to be ancient in the same sense that most of the mines of Southern Rhodesia are ancient, its history, nevertheless, goes back considerably farther than that of most of our present-day mining enterprises in South Africa; for when Sir Francis Galton made his memorable journey into Ovamboland in 1851 he fell in with native caravans conveying copper ore from Tsumeb to Ondonga, where they were smelted by the Omundonga, a tribe of Ovambos particularly skilled in metal work. Galton does not appear actually to have visited the native workings, but we find passing reference to them in the journals of several later travellers, at least one of whom cast rifle bullets from lead smelted from Tsumeb ores. The true magnitude and possibilities of the deposit only appear to have been realised some ten years ago, when an expedition sent out by the South-West Africa Company, of London, was able, by a comparatively insignificant amount of exploratory work at Tsumeb and the less important occurences in the Otavi Mountains, to prove the existence of copper and lead ores to the value of over two million pounds. This brought matters to a head, and the Otavi Mining and Railway Company, which had acquired the mineral and land rights over the Otavi area from the South-West Africa Company, at once set about to link up Tsumeb with Swakopmund by means of a narrow-gauge railway. Since the completion of the latter in 1908, Tsumeb has probably taken pride of place among the base metal producers of South Africa.

The Deposit.

The Tsumeb deposit takes the form of two large ore lenses, each some hundred and fifty yards in length, and having a maximum width of twenty yards, which are separated by a narrow bar of a peculiar arenaceous rock. The country rock is a grey dolomitic limestone belonging to the Otavi system, which at this point has been intensely folded and disturbed. Of the vertical extent of the deposit nothing is as yet known, but it is becoming increasingly evident from the underground developments that the extremely pessimistic forecasts made by several engineers of standing as to the persistence in depth of the ores were without justification.

The ore as mined is a coarsely crystalline mass made up principally of the sulphides and carbonates of copper and lead. The composition varies considerably in different parts of the mine, so that from large masses of practically pure copper glance and galena there are all intergradations to the most intimate admixtures of these and other minerals. To the specimen hunter Tsumeb is a veritable paradise, and it is extremely doubtful whether any other deposit affords so beautiful and so varied an assemblage of ore minerals. The following are among the more important: Copper glance, malachite, azurite, linarite, chrysocolla, galena, cerussite, anglesite, pyromorphite, a little zinc blende, and fair quantities of the rare mineral, mottramite. Both the copper and the lead ores carry a small percentage of silver.

Mining.

Down to a depth of forty feet the deposit was worked open-cast, but below this underground methods had to be resorted to. As was to be expected, the underground mining of the large and brittle mass of ore presented considerable difficulties, and these have only recently been overcome by the adoption of a system of overhand cross-stoping with concomitant waste filling, similar to that in vogue in the German potash mines. In consequence of the change from open-cast to underground working, the mining costs have gone up from eleven shillings per ton to twenty-three shillings, a figure which would certainly appear to be capable of considerable reduction. The rock broken in the stopes is carefully sorted, and only ore is hoisted through a vertical shaft of rectangular cross section situated to the south of the mine workings.

Treatment.

On arrival at the surface the ore was, at the time of my visit, being tipped into large railway trucks standing on a sorting floor and there subjected to a very



Bushman women employed for sorting ore at the Tsumeb Mine.
(Steel headgear of vertical shaft in background.)

thorough picking process by a picturesque medley of native workers, prominent among whom, by reason of their diminutive stature, were a number of women belonging to the Kung tribe of Bushmen, whose habitat is the north-western Kalahari.

This hand picking has for its object the separation of the ore hoisted into : (1) A high grade copper product —principally copper glance—which is bagged for export, it having being found that it pays to export any ore carrying over 12 per cent. of copper; (2) lead ores, largely galena, and low grade carbonate copper ores, which are trammed to the mine smelter ; (3) fines which, on account of their high copper content, are also bagged and exported. The export ores need not long detain us. Suffice it to say that they are shipped to the United States for treatment ; there being a regular ore-steamer service between Swakopmund and New York. During 1911 the Otavi Company exported 31,600 tons of such picked ore, averaging 16 per cent. copper, 24 per cent. lead, and nine ounces of silver to the ton ; the bulk of this having been mined at Tsumeb.

The Smelter.

The smelter, which is situated some distance to the north-west of the mine workings, is equipped with two rectangular water-jacketted blast furnaces, measuring three metres by one metre at the tuyeres. The lead and low grade carbonate copper ores from the picking floors are here mixed with suitable fluxes and smelted by means of imported Westphalian coke. The charge is so proportioned that the sulphur content of the galena is amply sufficient to combine with all the copper contained in the ore so as to form a copper-lead-iron matte, while the bulk of the lead is reduced to the metallic state. The products of the blast furnace smelting are, therefore, piglead, a matte, which during the last financial year averaged 47 per cent. copper, 26 per cent. lead, and 11 per cent. iron ; and a silicate slag. During 1911 there were produced 2,040 tons of pig lead and 2,220 tons of matte. Both the lead and the matte are exported to Germany for further treatment. In the case of the matte, this treatment takes the form of roasting down to 4 per cent. sulphur, after which the desulphurised material is fused with quartz, the product of the fusion being copper containing a little lead, which is further refined ; while the bulk of the lead and iron go to form a slag, from which the former is subsequently recovered.

General Considerations.

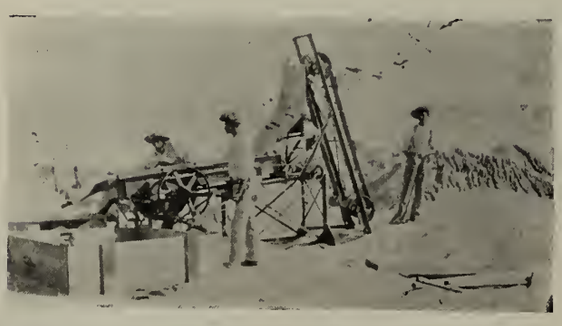
There are three features in connection with the Tsumeb Mine by which every technical visitor must be impressed. These are : (1) The inefficiency of the native labourers ; (2) the almost entire absence of labour-saving appliances, and in particular of a modern picking plant ; (3) the non-employment of concentrating machinery.

(1) This is due to a variety of causes, prominent among which are the incompetence of the mine overseers and the low moral standard of the white miners. The majority of the latter openly cohabit with native women, and can therefore hardly be expected to command the respect of the mine boys.

(2) For the absence of a modern picking plant there is no apparent justification, as it is quite obvious that by a simple installation of trommels, conveyor belts, and hoppers, the picking could be done quite as efficiently and certainly far more cheaply than is at present the case.

(3) In adopting what might be described briefly as a direct-smelting process, the engineers responsible for the present scheme of treatment appear to have followed a very wise course, as the concentration of so complicated an ore presents extraordinary difficulties, and it is extremely doubtful whether the ultimate recovery by concentration, followed by the smelting of comparatively clean products, would have been any better than it is by the method now in vogue, while the costs would certainly have been much higher.

In conclusion, a word of praise must be offered to the German engineers and metallurgists who, in the face of enormous difficulties and in what was until quite recently an absolute terra incognita, have so successfully solved the many perplexing problems presented by the mining and the treatment of Tsumeb ores.



Schuller Classifier, Lübeck, German South-west Africa



Round Buddle; Prospecting Works in barren blue ground, Gibeon, German South-west Africa

The Past, Present and Future of Mineral Exploration in the Transvaal

By OLIVER KING, A.M.A.I.M.E.

THE exploration of the Transvaal for mineral deposits is matter of comparatively recent history. Fifty years ago practically nothing was known of its mineral resources. Southwards of the Limpopo the ancients appear to have done very little mineral exploration, certainly nothing comparable with that of the old workers in Rhodesia, whose operations covered so closely such a large range of country that there is little left for the latter-day prospector than the further exploration of the



The first Mine Laboratory in the Transvaal, Pilgrim's Rest, 1885.
The earliest researches in the treatment of Gold Ore were made in the hut on the left. The first offices of the Transvaal Gold Exploration and Land Co., Ltd., on the right.

gold shoots already opened from the surface by those unknown miners of the past. There are indications in Rhodesia of wonderfully systematised prospecting. Over enormous areas one frequently sees the surface float collected into more or less regularly-spaced heaps, which have occasionally been broken down to walnut size. It is surmised that slave labour was utilised for this collection of the surface quartz, the skilled men following up and closely examining the heaps of rock for visible gold. There are, too, mines working to-day on deposits occurring under such unusual conditions that it is very unlikely that modern prospectors would have located them had it not been for the workings of the ancients.

Turning southwards to the country between the Limpopo and the Vaal Rivers, there are a few ancient workings for base metals, and still fewer spots at which it may be certainly said that gold was sought for and worked.

Following the gradual opening of the country by the Boers, the Transvaal of fifty years ago was practically a virgin country for the prospector, covering the widest range of geologic periods from the basement granite upwards. From Baines' "Gold Regions of Africa" it is evident that in the fifties and sixties more was known and thought of the mineral occurrences north of the Limpopo than of the possibilities of the Transvaal territory to the south. There were, however, many enterprising prospectors at work, and from 1870 to 1885 most of the present known mineral centres were located, the various discoveries culminating in 1886 in the finding of the gold-bearing conglomerates of the Witwatersrand.

So recently, however, as twenty-one years ago, when the first number of the "Mining Journal" saw the light, one frequently heard the Transvaal described as a "land of samples." The subsequent enormous expansion of the Rand gold fields, the great diamond and coal mines, and, inter alia, the constantly growing tin production of the Waterberg, have proved the baselessness of this assertion. Optimists now frequently express the opposite opinion, and assert that the surface has only been scratched. Perhaps so, and there are certainly large areas of the Transvaal still unexploited. Yet the exploratory work of the last twenty years or more has resulted in very few discoveries of value, and one must recognise the invaluable services of those hardy pioneers who, without our present knowledge, and surrounded by difficulties, seem to have spotted any promising outcrop, and to have located almost all the indications which are being followed up to-day.

With the exception of the tin mines of the Waterberg and Bushveld and the Premier and other diamond deposits, there are practically no recognisedly valuable mineral occurrences which were not discovered upwards of twenty years ago. The proving of the lateral and dip extensions of the Main Reef beds cannot be regarded as discoveries, whilst the extensions on the reef planes of the Lydenburg fields are only the natural sequence following on their location and recognition at sundry spots by the earlier workers. Apparently these old



The first Mine Manager's Residence in the Transvaal.
The Bungalow, Pilgrim's Rest.
This was erected by Mr. Robert Allen, the first Manager of the Transvaal Gold, Exploration and Land Co., Ltd., in 1882.

prospectors were either not acquainted with cassiterite, or were not looking for it, but they found and prospected all the presently known gold fields, the lead, zinc, and copper deposits, as well as the occurrences of cobalt, bismuth, mercury, etc. Few spots have been found since where outcrops containing minerals of value were not located, and at least superficially examined.

Following the discovery of gold in the banket beds, it seems strange that so few discoveries of value have been made as compared with those of the earlier workers. It must be remembered, however, that they were working in a practically untouched country, and may even have been advantaged by having no theories

to follow, and that, consequently, they examined in an open-minded way all they came across in their work. In those earlier years, men of world-wide experience who visited the country were greatly prejudiced by previous knowledge, and were often quick to condemn any occurrence which was dissimilar from what they



The first fine grinding plant in the Transvaal—at the Brown's Hill Mill, Pilgrim's Rest.
This consisted of 4 Californian Pans with Settlers, etc. Erected 1883, Enlarged 1889.

had seen elsewhere. I remember, in the earlier days, a much-travelled mining man looking at the dolomite ledges of the Lydenburg district, and remarking, "You won't find any gold worth working in these beds, but you may find silver." Later history has shown abundantly how rich are the gold deposits in these beds, whilst silver only occurs as an adulterant of the gold, or in its association with lead or bismuth. Possibly sometimes a little knowledge may be a help rather than a dangerous thing.

The old-time prospector working on his own, or backed by a few friends, always started out with the idea that it was reserved for him to find the biggest and most valuable prospect which the world had ever known. Call it greed, or what you like, he risked health, life, and future in the quest. The prospector of to-day sets out with salary, expenses, and equipment, and is not out of pocket or prejudiced if his work give no result. The earlier workers had the advantage of going over untouched ground, and were the keener, as their success depended solely on results. Most of the prospecting of the last twenty years has been carried out departmentally under the ægis of exploration and land companies and syndicates by men of much greater scientific attainments, and with the accumulated knowledge of the older workers, but who naturally have not the personal incentive of those old fortune-seekers.

To-day, as in the past, prospecting rushes centre round new finds. Given a very promising discovery, there is always a great rush to secure farms in the vicinity, and "on the extension," with a view to flotation of companies and syndicates, and the rapid creation of marketable scrip. The prospecting of large areas is then left to one or two prospectors controlling large gangs of Kaffirs. Compare this with what obtained in the early rushes to Moodies and De Kaap, when hundreds, nay thousands, of prospectors scattered over the country in the neighbourhood of the earlier finds and, working independently, examined every surface indication so closely that few obvious indications were left untouched.

For the last twenty years prospecting has been further handicapped by the spell of the Main Reef beds, and their regularity in the Central Rand. The tendency has been to induce workings on certain lines, or in certain rock beds, beyond which prospecting is assumed to be useless and any new find impossible. A theory dear to many, and often the fetish of the layman, is that the successive strata of the world have been built up like the onion, in concentric skins, and that geology is as simple as turning the leaves of a book. Those who have attempted boring for the Main Reef in distant quartzites, of apparently the same age as the Central Rand, have found that the problem they have set out to solve is not so delightfully simple as it appeared. The assumption of continuity of value in quartz reefs, too, has received many rude shocks. Much scientific research has been applied to mineral exploration, but its fruits will probably be more apparent in years to come than they are to-day. The old Cornishman's aphorism, "Where she be there she be," has undoubtedly its hidden grain of truth.

No one will deny the advantage of scientific training, more especially in the following up of discoveries, but the fact remains that the genus prospector is now a rare bird. The conditions of the sub-continent which led men to seek their fortunes independently in the early days of the Transvaal may not be in existence to-day, yet the discovery of a new field of individual enterprise —such as the alluvial fields of old Lydenburg or the Moodies' mountains—would bring into the arena a new generation of independent workers impelled by the same ideals which their forerunners followed. The material must be in existence awaiting the call, but the paid prospector, who does not depend on the results of his work, is a poor substitute for the man who gave up calling, and home, and friends to seek his fortune in the unknown.

Prospector nascitur non fit. It is not merely that he should have the driving force of being dependent on the results of his work, great as that influence may be. The finest prospectors have something beyond that, something more essential than scientific training or keen observing powers. The ideal prospector seems to have some inherent power like the bloodhound or the pointer. To him prospecting is a joy. He simply can't help prospecting, and goes on buoyed up by hope against every discouragement. Such men, to-day, are exceedingly few. The story of some of the earlier prospectors of the Transvaal— alas, few of them are still alive—would read like a romance, and still remains to be written. Baines' great book is the classic of the subject, and one wonders what he may have said and done had he not been cut down at the most interesting point of his career.

Glancing away from the Rand at the leading discoveries of the eighties, two finds stand out pre-eminently, those of the Sheba and Theta mines. The Sheba outcrop stood out conspicuously and was phenomenally rich. In 1886, I stood in the original quarry with Edwin Bray. This quarry furnished ore in large quantities, and over a great width, assaying from ten to twelve ounces to the ton. On the other hand, the outcrop of the Theta Reef was entirely obscured, and was only found after many months of arduous prospecting which followed the indications from the creek level to the top of the range. I have a view of the original open working on this reef, which shows a



Loading Ore from the Theta Reef for transportation to the Brown's Hill Mill, 1888.

bulge in the lode which assayed fifteen ounces on a thickness of fifteen feet. A single claim on either of these finds furnished many times over the yield of any claim on the Rand.

The question will be asked, what are the chances of further discoveries in the Transvaal; firstly, as to the

already worked portions ; and secondly, in the extensive scarcely touched areas? Is it likely that more such plums as the Sheba and Theta mines will be found? As regards quartz reefs in the Barberton beds of the De Kaap fields, it seems unlikely that many further surface finds will be made. Even here, however, it must



Open Working on the Theta Mine in 1889.
The Reef was first located near the top left hand corner of picture, and may be seen, with its overlaying chert, dipping nearly vertically to the right.

be noted that the exceedingly rich Zwartkoppies shoot stood out above the surface, and yet was not discovered till nearly ten years after the original discovery of the Sheba, though but a mile or so away. Generally, however, in already prospected schistose country, further discoveries are more likely to be made by the further following in depth and extension of already known occurrences. Not too promising surface outcrops may at any time develop enlargements and enrichments constituting valuable mines. Scattered over the De Kaap ranges are many old workings which, as time goes on, will be further exploited, and in some cases will yield rich prizes.

The greater field for gold exploration would, however, appear to be in the dolomites and the reefs associated with those beds. Here the outcrops are almost always obscured, and much painstaking and systematic following of gold indications is needed to reach the parent seam. It is practically certain, however, that many rich finds will still be made in these beds, even at widely separated points. There are great stretches of flat-bedded dolomites in the Transvaal which are exceedingly difficult to prospect, as any gold-bearing seams in them are almost always interstratified, but which will undoubtedly some day furnish rich areas. In the Pretoria beds many occurrences of both gold and base metals have been located which at present are under a cloud. In time to come these deposits will be more fully followed up, and further discoveries will be made. There is a further rich field of mineral occurrences in the igneous area of the Bushveld, which at present is only looked on as a country of most varied samples.

Speaking widely, it may be said that all the known mineral occurrences of to-day have been found by following up surface indications, and that blind prospecting on theoretical lines has been very barren of results other than of academic interest. Such work can only be undertaken when backed by large financial resources, and against long odds. Even here, the search for further wide extensions of the Main Reef beds may some day achieve unexpected success.

The prospecting of the last twenty years has not gone far afield of the areas covered by the old prospectors, and brilliant discoveries of the future are more likely to be made in the immense schist areas, the rugged mountain ranges of the dolomites, and the great stretches of Waterberg contact, which have as yet been scarcely examined and prospected. Prospecting in such unexplored areas should not be confined to recognised reef lines, but should also be extended to formations and under conditions which have not as yet been found to contain minerals of value. However valuable in exploration geologic theories based on past experience may be, yet the prospector should only make such knowledge subservient to his observing powers and researches, and not servilely follow it.

Summing up the position to-day, it would seem that the chances of making original discoveries in the already explored areas is small, the superficial work of the earlier explorers having been much more thorough than they usually get the credit for. In such areas, the following up of older finds may, and in many cases certainly will, develop valuable mines. There still remains a great area of the mineral-bearing formations of the Transvaal in which great prizes may be looked for, and, as time goes on, will certainly be won. For the time being, at least, the forces which actuated the old adventurers seem to be absent, and the concentration of land ownership on a large scale tends to prevent individual enterprise. Moreover, in recent years prospecting has been almost solely directed towards the discovering of big things, admitting of large capitalisation, and development and equipment accordingly. Latterly, however, a much healthier position is being established. The small worker is changing the aspect of outside work, and even the large corporations do not disdain to erect small trial plants working on tributors' lines. These smaller efforts must result in great good for the country, and in many cases will lead to much wider development and enterprise and the opening up of many discarded prospects.

Political speakers of late frequently assume that the time is not far off when the minerals of the country will be exhausted and reliance will have to be placed entirely on its agricultural resources. Considering the great preponderance of the gold export of to-day, there may be much apparent ground for this apprehension, though the fear is generally preliminary to the desire to take as much as possible from the mining industry, which will someday be a thing of the past, and to devote as much as possible to the agrarian industries which will go on for ever. These orators are led away by the fact that the country is now passing through a depressed period of mineral enterprise. Yet renewed periods of prospecting enthusiasm will recur, and as improved methods and better working facilities are introduced, many old prospects will be brought into the active field and many new finds will be made, to some extent in the older fields, but principally in the now little explored and difficultly accessible areas of the country. Gradually, too, attention will be drawn to the great iron deposits, and a big iron and steel industry will be created bringing



The first 10 stamp heavy Mill in the Transvaal, erected in 1883. Brown's Hill Mill in 1888.

all sorts of manufacturing industries in its train. With its immense coal resources, the Transvaal cannot fail to retain its position as a mineral country and to become of much greater and of more world-wide importance than it is to-day, even when its gold yield has receded to a secondary place.

Transvaal Gold Mining Dividends

The Colossal Record of a Quarter of a Century :: Twenty-five per centum of the Gold Won
Individual Contributions of the Various Mines

THE first Transvaal dividends from mining sources of which there is any record, apparently, were those of the Jubilee, Jumpers, and Wemmer, in the year 1887, the following being the facts as stated in the Chamber of Mines list :—

Company.	Issued Capital.	Rate per Cent.	Amount of Distribution.
Jubilee	£12,000	25	£3,376
	15,000		
Jumpers	42,000	5	2,100
Wemmer	10,000	57	7,500
	28,000		
			£12,976

The Wemmer, as befitted its position at the very centre of what was afterwards to be the greatest gold field in the world, made, it will be seen, a magnificent commencement, a circumstance that is little to be wondered at when the richness of the ore that was treated is taken into consideration. As late as 1891 the plate recovery from banket milled during the half-year ended September 30th averaged 19 dwts. 3.6 grains per ton. "The average assays of the tailings during the half-year," remarks Mr. C. S. Goldmann, in his well-known book on the Witwatersrand, "show 9 dwts. 18½ grains, whilst the milling assays show a loss of free gold of 15 grains per ton, so that the mineral as it came from the mine carried 1 ounce 8 dwts. 22 1-10 grains per ton, and there was got from the mill upon the copper plates 66½ per cent. of the gold contained in the mineral." The company had so much gold that sands worth nearly £2 per ton were "tipped down into the empty stopes of the mine," in order to get rid of them. Some 1,522 tons were treated by the Adair-Cruikshank Company in 1891 and yielded 47 per cent. of their fire assay. The results doubtless gave the management and board of directors "furiously to think," for it is said by the writer just mentioned, after a reference to this early sand-filling enterprise, that "the plan has now been abandoned."

The Jubilee, lying within a stone's throw of the Wemmer, made a fairly good second in the dividend-paying way, and here, also, the astonishing richness of the ore near the surface made matters by no means difficult in this direction. Again referring to Goldmann, we find that at the east end of the mine, at the second level, or one hundred and sixty feet, the South Reef was from two to three feet wide, assaying from six to nine ounces. The Main Reef "is a body of ore from six to eight feet wide, with a good leader, bulk assaying from ten to fifteen dwts."

The Jumpers, which came third on the somewhat brief list, had nevertheless the distinction of appearing amongst the first three companies to begin a period of dividend paying by the gold mines of the Transvaal which expanded year by year, until, in 1909, it reached a record figure for the year of £9,523,518, and a total, from the beginning, of £65,955,574. Since then the process has been continued, until, at the end of 1911, the total sum paid in dividends by the gold mines of the Transvaal amounted to £83,171,296. The details of this enormous return are set forth below, together with a tabular statement showing the value of the gold yield year by year. The dividend figures have been obtained from the twenty-second annual report of the Transvaal Chamber of Mines, and those relating to the output have been compiled by the statistical branch of the Chamber from the Government blue books :—

Dividend List (Transvaal Gold Mines), 1887-1911.

	Dividend.	Gold Yield.
1887	£12,976 ...	£169,401
1888	127,352 ...	967,416
1889	461,644 ...	1,490,568
1890	299,557 ...	1,869,645
1891	355,600 ...	2,924,305
1892	974,041 ...	4,541,071
1893	1,042,539 ...	5,480,498
1894	1,727,433 ...	7,667,152
1895	2,218,402 ...	8,569,555
1896	1,743,632 ...	8,603,821
1897	2,956,981 ...	11,653,725
1898	4,996,510 ...	16,240,630
1899	3,211,766 ...	15,452,625
1900	6,600 ...	*1,481,442
1901	422,413 ...	*1,096,651
1902	2,127,726 ...	*7,301,501
1903	3,368,837 ...	12,628,657
1904	3,938,802 ...	16,028,583
1905	4,859,717 ...	20,854,440
1906	5,741,761 ...	24,616,704
1907	7,098,212 ...	27,410,210
1908	8,757,882 ...	29,986,469
1909	9,523,518 ...	31,005,939
1910	9,130,958 ...	31,995,266
1911	8,066,437 ...	35,041,485
	£83,171,296 ...	£325,127,075

*War period

A comparison of the totals of the two columns in the table given below shows that approximately 25.5 per cent. of the value of the gold recovered has been paid out in the shape of dividends. At various periods the ratio between yield and dividend has swung more or less widely from one side to another of the average, particularly in 1909 and 1910, and obviously, by contrast, in 1911. The first of these three years not only produced the highest annual declaration ever made, before or since, but the ratio was the highest ever reached, being as 30.7 to 100, or more than five per cent. higher than the ratio of 1911. The details of the total of £83,171,296 are given here :—

Company.	No. of Last Dividend.	Total Rate per Cent.	Total Amount of Distribution.
Robinson	39 ...	326 ...	£8,955,938
Crown Mines	21 ...	957½ ...	4,760,812
Simmer and Jack Prop. .	19 ...	287½ ...	4,116,461
Ferreira	36 ...	4,415 ...	3,919,250
East Rand Proprietary...	17 ...	130 ...	3,043,664
Ferreira Deep	17 ...	327½ ...	2,980,250
Robinson Deep	18 ...	315 ...	2,950,186
Crown Reef	40 ...	2,404 ...	2,867,900
Village Main Reef ...	22 ...	590 ...	2,581,543
Langlaagte Estate ...	43 ...	494 ...	2,543,580
New Primrose	37 ...	762½ ...	2,277,525
City and Suburban ...	24 ...	398¾ ...	2,159,913
Rose Deep	21 ...	382½ ...	1,916,125
Geldenhuis Deep ...	24 ...	562½ ...	1,881,990
Geldenhuis Estate ...	30 ...	835 ...	1,640,750

Company.	No. of Last Dividend.	Total Rate per Cent.	Total Amount of Distribution.
Witwatersrand Deep	12	285	1,495,093
Robinson Central Deep	9	337½	1,485,000
Van Ryn	10	282½	1,344,500
Bonanza	16	662½	1,325,000
Durban Roodepoort	75	1,075	1,322,583
Angelo	13	333¾	1,231,648
May Consolidated	27	487½	1,399,100
New Kleinfontein	15	162½	1,226,125
Nourse Mines	14	167½	1,104,939
New Modderfontein	11	82½	1,072,500
Knights Deep	13	165	1,061,817
Meyer and Charlton	44	1,045	1,035,308
Witwatersrand	15	242½	1,000,625
New Heriot	35	912½	1,000,287
Wemmer	27	1,237	871,180
Driefontein Consolidated	11	195	741,111
Henry Nourse	12	590	737,500
New Rietfontein	11	135	711,093
Roodepoort United	21	285	609,500
Jumpers	26	590	576,500
Glen Deep	10	85	510,000
Randfontein South	3	25	500,000
Jubilee	80	1,215	495,479
Cason	3	93¾	492,188
Ginsberg	17	262½	477,375
Village Deep	7	45	477,303
Treasury	12	163⅛	469,025
Glencairn	14	107½	448,750
Wolhuter	8	60	443,000
Johannesburg Pioneer	30	2,107½	442,575
Porges Randfontein	7	70	342,500
Worcester Exploration	37	412½	338,037
Consolidated Main Reef	7	37½	322,781
Jumpers Deep	7	57½	301,240
Cons. Deep Levels	6	160	299,600
Langlaagte Deep	4	35¾	286,666
Main Reef West	5	55	250,589
Salisbury	32	405	248,823
Rietfontein A.	7	70	237,688
South Randfontein	5	50	225,000
Champ d'Or	11	167⅔	219,196
New Goch	5	37½	206,250
New Comet	5	52½	203,125
Princess Estate	8	72½	184,627
Langlaagte Block B.—			
Preference	16	128	180,950
Ordinary	2	12½	
Robinson Randfontein	3	30	180,000
North Randfontein	4	40	180,000
New Unified	7	60	150,000
Durban Roodepoort D.	5	32½	143,000
Stanhope	21	327½	109,670
New Chimes	13	115	95,049
West Rand Consolidated	1	3¾	74,228
Orion	14	132½	65,750
Lancaster	2	20	65,105
East Anglian	3	230	64,400
French Rand	2	12½	64,250
Luipaardsvlei	3	15	59,760
Jupiter	1	5	50,710
Geldenhuis Main Reef	4	30	45,000
Knight Central	1	5	45,000
Vogelstruis Estate	4	20	44,990
York	6	80	29,600
Langlaagte Royal	8	40	26,500
Windsor	1	20	20,000
Lancaster West	1	10	19,500
Paarl Pretoria	1	25	18,750
Aurora	3	35	18,250
West Rand Central	3	17½	15,477
New Aurora West	3	15	10,000
Heriot	3	15	8,996
New Crœsus	2	10	7,500
Moss Rose	4	20	7,141
Vogelstruisfontein	3	15	6,750
Golden Kopje	2	7½	5,625
Meyer and Leeb	4	27½	4,075
Chimes	2	10	4,000
Royal	2	17½	3,500
Moss Rose Extension	1	4	3,200
Evelyn	1	10	2,600
Percy	2	20	2,000
Grahamstown	1	10	1,650
			£80,199,095

Outside Districts.

Nigel	31	397½	780,899
Transvaal G.M. Estates.	11	125	755,280
Sheba	21	961¼	747,220
Glynn's Lydenburg	20	240	403,366
Transvaal G. Expl. and Land Company	—	57½	191,969
Worcester Exploration	6	47½	45,467
Birthday (Klein Letaba).	4	15	22,150
United Ivy	6	47½	45,467
Barrett	3	14⅛	8,500
New Clewer Estate	1	5	5,000
Total			2,972,201
Witwatersrand			80,199,095
			£83,171,296

NOTE.—The total rate per cent. shown in the foregoing tables is the sum of the rates at which the various dividends have been declared, and is not necessarily a total rate per cent. corresponding to the total sum distributed and the present issued capital.

The Robinson, as will be seen from the above statement, has abundantly earned the distinction of being the greatest gold mine in the world, the total dividends paid by the company to the end of 1911 being greater than the whole annual dividend from Transvaal gold mines in the same year, and nearly double the aggregate sum paid by the next on the list, the Crown Mines, in itself no mean member of a group each of which has paid well over a million sterling since the days its gold-mining operations were begun.



Health and Living Conditions on Rand Mines

The Sociological Work of the Mining Houses :: Clean, Healthy Homes and Workers' Proprietorship
The Campaign against Phthisis :: What is Still Wanting

DURING the course of the last twenty-five years, while the mining industry of the Rand, endowed with all that goes to the making of a strong and vigorous life, has been responsive to the impulse of expansion and development which is a national consequence of this condition, there have been various epochs when particular phases of progress have been more or less marked, and have influenced, in greater or less degree, the operation of every branch of activity into which the work of mining and recovering the precious metal has ramified. It is not necessary, perhaps, to enumerate these periods or dwell in detail upon their characteristics, but, among the more prominent, it may be remarked, are the amalgamation period, that of the Chinese experiment, and the era of the low working cost crusade, to take only three well-defined stages of mining policy which, although they overlap somewhat, are sufficiently marked to illustrate the special influences referred to. The present period of mining, it seems to us, is likely to be no less distinguished than the others by special tendencies and a distinct policy which are not difficult to discern already in the efforts that are being made to ameliorate the living conditions of the miner, both on the surface and underground. It is not to be assumed that these efforts are being made now for the first time. Ever since the Main Reef series gave promise of permanence the condition of the white worker has attracted the attention of his employers and been the subject of their earnest consideration. In 1897, when a Commission was appointed by the Kruger Government to investigate and report upon the many grievances and burdens of the mining industry, the incidence of the heavy railway rates upon the living conditions of the white miners was frequently and extensively discussed by directors, engineers, and others who appeared to give evidence. "The conditions prevailing here," said Mr. J. Harry Johns, then general manager of the Ferreira, "differ from those of many other countries ; the brute force required in mining we endeavour to get from the natives, while we aim to get intelligence and energy in our white miners, and if we have to pay a little more for it, it is, nevertheless, the cheapest labour we can employ. . . . White labour constitutes a very important item of expenditure on our mines, and if, through a reduction of railway rates, duties on foodstuffs, etc., cost of living becomes sufficiently reduced to enable our white employees to settle here with their families much of the money now being sent to other countries would be spent here."

Pre-War Difficulties.

The fact that the difficulties which beset the industry in pre-war days were so intolerable as to necessitate the nomination of a State Commission to take evidence upon the position, and the general feeling of uncertainty and apprehension which prevailed with regard to the future, particularly about this time, abundantly explains the small measure of achievement on the part of the mining groups in the matter of improving the surroundings of their employees. Later on the war intervened, and in the long months of re-organisation and re-establishment which followed the consideration of sociological schemes was of necessity delayed. The provision of an adequate labour supply was an obvious preliminary to the planning of methods by which the labour force could be maintained in circumstances which would ensure efficiency, and it will readily be admitted, we believe, that the efforts required to secure the first condition were such as demanded almost undivided attention. It was not long, however, before the problem of the miners' personal claims was taken seriously in hand. If humane motives were insufficient to have prompted this course—and there is no reason to suppose that directors and mine managers are less endowed by nature with these sentiments than are other men—the irresistible laws of industrial economics would have been cogent enough. There are few employers of labour upon any scale, and probably none who employ men in large numbers, who fail to recognise that importance of healthy minds and healthy bodies which is concisely expressed in one of the oldest of extant Greek apothegms and has been re-discovered, so to say, in the great workshops of to-day. It is unnecessary to consider the question of motives in this connection ; the point we wish to make is that upon the lowest grounds of elementary self-protection, and the teachings of ordinary common-sense, it was incumbent upon the mining houses of the Rand to undertake those schemes of general betterment of the miners' living conditions which it is the humour of their critics to speak of as having been forced upon them. The problem of the miners' personal claims, as we have said, was taken in hand as soon after the war as circumstances would permit, and one of the first results of this enterprise was the improvement of miners' quarters and the planning of industrial villages, which were carried out with no niggardly hand, and with the assistance of the best available architectural experience.

Healthy Mining Villages.

The development of the housing scheme, particularly under the direction of the boards of the Eckstein group, was not long in progress before comfortable and cheerful homes, with proper sanitary provision, were everywhere in evidence ; other groups were no less active in carrying out similar improvements, until to-day the standard of artisan dwelling accommodation considered necessary by the mining houses may be said, unhesitatingly, to be in itself adequate and well devised, and, generally, to be equalled by few in any other part of the world and excelled probably by none. The process of betterment in this respect has not ceased, but is still active wherever the means of carrying it out are at hand, and invariably in those places where additional housing room has to be provided. The personal claims of the miners do not end here, however. There are others, and one cannot state them better than as they appear in a statement handed in to the Mining Industry Commission of 1907 by Mr. John Joseph Ware, on behalf of the Witwatersrand Trades and Labour Council. On the subject of house accommodation, the statement proceeds : "Rents here are very high and few of the employees own their own properties. If the State could see their way to co-operating with workmen towards bringing about a method that would enable the employees to acquire homes of their own, then these men, having a stake in the country, would feel interested in the welfare of the town and in the preservation of their property. They would feel that they were not a mere floating population, but that they had an interest in the stability of every-

thing in the vicinity. Moreover, if a small quantity of land, say a quarter of an acre, for example, could be attached to each home, then, during the summer season there would be an opportunity for the mine worker, when he left his occupation, to indulge in the beautiful, useful, and profitable business of attending to a garden, where he, his wife, and children could meet in common interest; then there would be some home life for them, instead of, as is very often the case in a mining district, the mine worker going from the mine, taking his evening meal, then resorting to the hotel or town away from his family."

The Small Ownership Scheme.

In spite of the idyllic beauty of the scene conjured up so vividly by Mr. Ware, and regardless of the sociological advantages so accurately outlined by him, the Government has, until lately, displayed no eagerness to fall in with the proposals. It has been left to the mining houses to formulate a scheme whereby miners should become possessed of all those real advantages which attach to the ownership of a home and even a modest portion of land—and in this, as in other humane and elevating endeavours, the Eckstein group, represented by Mr. Raymond W. Schumacher, has taken a decided and vigorous lead. Mr. Schumacher has, in fact, identified himself with the small ownership movement to an extent that assures success, if success is possible, and it is gratifying to find that the Government,



A Distant View of Area Proposed for Mr. R. W. Schumacher's House Ownership Scheme. City Deep in Foreground

urged in that direction by Mr. Chaplin and others on his side of the House of Assembly, has latterly shown a disposition to assist an enterprise which is taking practical shape under such excellent auspices. It is difficult to say at this early stage of the proceedings how beneficial and widespread the results of the scheme are likely to be. If other circumstances prove as favourable as the hope to make them so is genuine and earnest, the advantages to the individual miner, the industry, and the State may well be incalculable. The undertakings so far referred to are those which concern the comfort and contentment of the miner when, as Mr. Ware remarks, he has "left his occupation," and when "going from the mine, taking his evening meal," he has time and inclination to ponder over the amenities of home and enjoy the delights of social intercourse. Before all these things are to be reckoned the healthiness of his surroundings underground, and in this matter, as befits its importance, the mining houses, abundantly regulated if only shabbily assisted by the Government, are working thoroughly and with determination.

The War Against Phthisis.

A campaign against the fearful disease known as miners' phthisis—a disease to the prevalence of which the mines of the Witwatersrand, by reason of their intensive methods of mining, are particularly exposed—has been in progress for some time past, and already, we are assured, the systematic course of action adopted has succeeded in throwing valuable light upon much that has hitherto been obscure, and has given ground for the belief that the scourge will, at no distant date, be practically eradicated. Among the measures taken to attain this end the numerous ventilation plans which have been carried out in the mines by means of mechanical appliances of the best kind and the largest dimensions may again be referred to. As sources of pure air, they not only remove some of the worst causes of enfeebled and diseased lung, in the shape of noxious "mine gases," but they contribute to the comfort and efficiency of the miner who is not of necessity exposed to these dangers. Here, again, there was no question of compulsion, but, as was shown at the East Rand Proprietary Mines, a voluntary endeavour to ameliorate living conditions as soon as the necessity for it became apparent and opportunity presented itself. The legislative action which has lately been taken with the object of providing for those who have become victims of the disease and those who may in the future succumb to its attacks, has met with the solid support of the leaders of the mining industry upon every point at which their sympathy could reasonably have been looked for. In only one respect, that of the apportionment of liability, have they felt called upon to make a protest. As the main source, directly and indirectly, of the prosperity and credit of the country, the gold mining industry of the Witwatersrand may justly claim to be relieved of a material proportion of the indemnity which has by common consent been granted by Parliament to those who have lost health and strength in the work of building up this great asset. If the basic principle involved in the doctrine of the unearned increment is a sound one, the argument is equally sound that those who enjoy an unearned increment from one end of the country to another, as a result of the enterprise of the mining companies of the Rand, should be liable to some taxation in respect of it, whenever taxation of the retrospective kind, such as that to indemnify phthisis, is decided upon. However that may be, the mining houses of the Rand have been satisfied with recording a protest against the indefensible attitude of the Government, and have set themselves to the work of assisting the Miners' Phthisis Board in every way in which assistance may be rendered.

The Government's Turn.

It is difficult to see in what other directions than those so far discussed in this article the leaders of the mining industry can strive to ameliorate the living conditions of the miner. That they can be improved still further, however, is a matter which requires little demonstration to those who, like the miners themselves, find their lines cast in the Transvaal. The cost of living is another and quite a different problem from that of the way of living, although it has no small amount of bearing upon it, as was shown abundantly in the voluminous evidence taken by the Kruger Commission. It is a problem that awaits solution at the hands of the Government.

The Witwatersrand Co-Operative Smelting Works

A Brief Description :: A Useful Adjunct of the Industry

CO-OPERATION has been the watchword of progress in Witwatersrand mining for years past, and it is perhaps a little remarkable that not until April of 1910 was co-operation introduced into smelting practice. Apart from such smelting, refining, and retorting work as is necessary in the ordinary routine of gold production, there are numerous bye-products, such as slags and black sands, the treatment of which are rather outside the province of the ordinary metallurgical department of a Rand mine. Some of the largest propositions, it is true, have the necessary smelting equipment for dealing with these bye-products, but the majority of properties are not prepared for operations of this nature; indeed, the greater proportion of Main Reef companies could hardly treat such bye-products at a profit. Previous to the establishment of the Witwatersrand Co-operative Smelting Works at the Robinson, the most common means of disposing of slags, pots, etc., was to sell them to scattered metallurgical works, which dealt in products of this nature.

All the Mines Customers.

Smelting operations commenced at the Witwatersrand Co-operative Works over two years ago, and now-a-days practically all the bye-products, etc., produced by the Witwatersrand mines are smelted at this establishment. One might say that all the mines of the Witwatersrand are now shareholders in this useful concern since, we understand, that the Jumpers, the West Rand Central, and the New Spes Bona are the only producing companies which are not members of the Co-operative Smelting Works. The three concerns cited above are now comparatively unimportant concerns, and they too, it is interesting to note, although not members of the Co-operative Smelting Works, send their bye-products, etc., to be treated there.

Types of Material Treated.

The works are situated on the site of the old Robinson chlorination works, and within a stone's throw of the Robinson company's mill. The works are well equipped for dealing with all classes of auriferous material other than the ordinary mill pulp sand and slime of a Rand mine. The chief sources of yield are pots, slags, liners, bricks, and black sands. Of course, the material sent for treatment varies considerably in different months, according to the output of such bye-products, etc., by the metallurgical department of the mines. In one month as much as three hundred tons have been dealt with by the Robinson works, but the next month a very much smaller amount of stuff may be received and dealt with. Fruitful sources of recovery are the pots used in the cyanide smelts. This class of material may yield from two to twenty or thirty ounces per ton, depending on the means of original treatment. These pots are dumped through a hopper in the roof of the works into the furnace, into which litharge is fed. The plumbago of the crucibles acts as a reducing agent, and the resultant buttons of lead containing the gold and silver are cupelled in a muffle.

Some Items of the Plant.

Amongst the more important items of the smelting equipment are a Fraser and Chalmers water-jacketed blast furnace, a batea pan, and a six-foot tube mill for the regrinding of the heavy black sands. These sands are transferred from the pan to a collecting tank, and are then treated in Pachuca vats. The gold is precipitated by means of the Merrill zinc dust and filter press process. The coke used at the works, it may be remarked, is obtained principally from Natal. The Witwatersrand Co-operative Smelting Works is doing useful service for the industry, and there can be no doubt that the establishment of this smelting equipment has done a good deal to improve the recovery of gold from the mines.



On the way to the Gold Fields in the Old Coaching Days

Our Metallurgical Prize Papers

Cyanide Treatment

Cyanide Treatment on the "Big Plant" Principle :: Central Cyanide Stations :: An Outline of a Possibility of the Future

By LESLIE STUART MUIR

It is obvious, from a study of Home and foreign mining and engineering journals that the world's mining communities are looking more and more to Rand gold mining for the initiation of those huge industrial enterprises and experiments which have achieved so large a measure of success on the Rand in the past. It is regrettable in the face of these results to have to note the failure of our big mining amalgamations to realise those results in working costs, which were so confidently looked forward to; but the inordinate growth in expenditure due to the ever increasing dearness of the native labour force may well be accepted in explanation of the disappointingly high mining costs of to-day, otherwise it would have been our pleasant duty to credit these big concerns with a measure of success that would have added no little lustre to the names of those responsible for the bold forward policy of the past five years. Indeed, we may safely say, despite past disappointments, progress in the shape of big undertakings and amalgamations will be a feature of the near future.

In these days of the mines' collective participation in great industrial concerns on the Reef, such as compressor and electrical power plants, assurance and labour combinations, etc., it would not be, perhaps, looking too far forward to discuss in this paper the merits of a "big plant" scheme in connection with cyanide treatment, especially as—thanks to present-day advancement in the various branches connected with the science of mining (engineering, chemistry, metallurgy, etc.)—the question of the practicability of such a scheme from mechanical and constructional points of view can be safely assumed to present no super-difficulties; indeed, it is safe to assert that the value only of such a scheme as a factor in the continued economic success of the industry would question its introduction, and we will proceed to show in this rough outline that this side of "big plant" cyanide treatment is one of great promise.

The topographical features of the Witwatersrand all favour the conception of conveniently situated cyanide treatment stations. We have a semi-liquid matter to handle in the discharged product from the mills, and this can be led almost any distance by gravitational force either in launders or pipes. The deep-deep ground of the E.R.P. Mines below the Angelo and Driefontein Deeps, the claims below the Jupiter for the Nourse Mines, the country beyond Germiston racecourse for the Gold Fields' mines in the Germiston district, the hollow beyond the Stubbs for the Randfontein group, etc., all present those topographical features necessary to a successful leading of the mill pulp by gravitation. Thus in conveying the "raw product" to its place of treatment we will be enabled to do so at an infinitesimal cost to ourselves.

Our primary object will be to erect a "big plant" to take the product of, say, six or more mines in a certain district, in a position favouring the gravitating of the pulp down from the mills. If need be, the site chosen may be as far removed as a mile or more from the nearest mill it will serve, and as we will practically "farm" our slimes and tailings, we could hope to secure this comparatively speaking out-of-the-way piece of ground at a low cost and of an extent commensurate with the scale of our operations.

Our utilisation of the open veld below the deep-deep claims for our purpose would mean much for such properties as the Kleinfontein, the Simmer and Jack, etc., where, in the rainy season the storage of slimes is always an anxious matter for the management. In fact, at one step, the necessity as it exists at present of finding more and more storage space for slimes and tailings would be removed, and an end put to the ever-increasing costliness of the present method of drawing the sands by mechanical haulage or conveyor belts up the ever-steepening inclines of sands dumps. In fact, the mines would benefit much by the removal of work of this nature from their crowded vicinities.

The sand residues would be dealt with collectively and on a big scale by a system of mechanical aerial haulage, say, of the Bleichert model, and the tailings from the six mines would be deposited over something like an area of fifteen acres of open veld, and at an appreciable saving to the mines concerned. Indeed, it would not be too much to say that the savings effected in the handling of the residues in the manner indicated would go far to establish the undertaking as a commercial success. Also an occurrence such as happened at the Simmer and Jack in 1907, when the mill was hung up for three days owing to the non-despatch of the sands, would be practically impossible.

The design, system, and method of the erection of the plant would, of course, afford some of our capable consulting and mechanical engineers ample scope for

the full exercise of their talents. Roughly, we might proceed to the erection of the plant at the new site in sections, in this wise: A near-as-possible duplicate plant to the plant of mine "A" (as conformity to the general system of the new plant will allow) will be erected, the pulp being diverted from the old plant at mine "A" into the launder which will lead it to the new works. Such of mine "A" plant as is suitable will then be re-erected at the new site and the pulp from mine "B" run into it, and so on. Of course, only serviceable, later-day plants would be re-erected. The sections thus utilised would, on the completion of the plant, form part of an integral system.

Numerous economies would be effected in various directions. The amount of native labour required would be greatly reduced, since the plant would be laid out on an improved up-to-date system, and consequently its native labour requirements would be reduced to a minimum. Economies, of course, would follow in white supervision, for on no portion of a mine's surface plant is white supervision so ineffectively employed; indeed, could two or three of the older plants be brought directly within the scope of a single staff, the same staff could efficiently manage the three.

A small metal cutting (zinc) factory might be equipped in connection with the new plant, and further economies effected by contracting for the wholesale purchase and transport of cyanide. Sampling and assaying, which is multitudinous at present, would be reduced to an appreciable extent, and further savings would be effected in the initial cost of power plant, since one set of motors would be utilisable for the emptying of several series of vats.

We might also look for a better all-round extraction, since the abnormal amount of slimes or chemicals, etc., which is characteristic of one mine's product would lose its effectiveness in combination with the free-milling of outcrops or average product of the majority of Rand mines. Thus the "problems" would automatically cease to exist with the starting up of the new plant.

An endeavour to fix the method and basis of the contracting of the Cyaniding Company (if an independent concern) with the mines might be outlined thus: The mines contracting with the Cyaniding Company for the treatment of their product would be compensated in the form of shares to the value of the loss on capital and expenditure incurred through the taking over of their cyanide plants by the new concern.

The mines entrusting their product to the new concern for treatment would render weekly and monthly check statements showing quantity mill crushings per diem, week, and month; and also daily screen samples of plates with weekly and monthly averages of values. Samples would also be taken below the plates, these showing the gold remaining in the pulp when despatched for treatment to the new works. Samples of the grade of the pulp leaving the tube-mill platehouse would also be necessary, since the grade of the pulp would be set down in the terms of the contract. These samples would be checked by samples (taken by the staff of the cyaniding works) at the head of the launder or pipe leading from the mine concerned, and, providing the grade, etc., were correct, the said mine would receive a *pro rata* share in the gold recovery, calculated on the certified values and tonnage it supplied, less working costs, of course.

The capital outlay of the Cyaniding Company would be moderate, since it would have to erect a small plant, and then remove and re-erect the second-hand plants of the contracting mines; consequently a large portion of the capital would be represented in shares held by the said mines.

The margin between low reduction costs and existing necessarily high costs would enable the new concern to contract on terms favourable to the mines and ensure a fair return on the mutual stock. A far better course would be for one of our big mining houses to initiate a scheme of their own to deal with the product of their own mines.

Space will not permit us to go into a statistical survey of this subject, but such as it is, we are sure it will reveal possibilities to every thinking man connected, especially, with the Rand gold mines industry.

Hydraulic Classification

By G. A. ROBERTSON

ALTHOUGH numerous methods of classification of pulp for tube milling have been introduced on the Rand within recent years, the spitzlutten in series is still commonly used, and provided it is adjusted to local conditions, good results are obtained. A common error in the lay-out of a spitzlutten lies in the grade of the launder leading from the tailings elevators to the V-shaped or pryamidal boxes being too great, and, together with the impetus given the stream discharging from the elevator, makes difficulty in getting full command over the velocity of the stream through the boxes. This difficulty can, however, be overcome by heightening the box in the last compartment of the series by having a slot above the overflow lip and sliding into this slot the necessary height of wood to reduce the velocity of the stream, this wood traversing the stream. Another method often overlooked is nature's good old rule that the velocity of stream decreases in the inverse proportion as it widens out. Under certain conditions where the first-named method may cause sand to bank in front of the boxes, it may be found advantageous to cut pieces out of the launder on each side of the spitzlutten and widen the stream, commencing a few inches below waterline at the first box. Only fine grades of sand take the extended route, thus allowing better settlement of the coarse sand within its travel zone. The conditions of classification remain fairly constant in this type of classifier. Owing to the small underflows, however, necessary for efficient work, they are liable to choke; but this can be reduced to a minimum by a suitable arrangement of screening in the launders before and after the elevation of pulp.

A classifier giving a liquid underflow adjusts itself better to changed conditions than a classifier that gives

a low ratio of moisture to solids. For instance, cones, cylinders, V-boxes, pyramids, and other types of classifiers used in series for classifying pulp prior to thickening in a dewaterer, will give, say, from the first box 150 tons of solids per twenty-four hours containing 60 per cent. moisture. If the feed is increased, the same size of nozzle may give 200 to 250 tons of solids in the underflow, containing between 40 and 50 per cent. moisture. Obviously, the volume of solids in the underflow increases at the expense of reduced moisture. On the other hand, take a diaphragm classifier giving an underflow of 300 tons of solids per twenty-four hours containing 27 per cent. moisture. If the feed to the classifier be increased, the moisture cannot be reduced more than 1 per cent., and a coarser overflow is inevitable. Experiments are being conducted with a view to overcoming this difficulty, and a fair measurement of success has already been obtained on one mine, the idea being to automatically increase or decrease the diameter of the underflow nozzle in accordance with the load. Hanging up stamps at week-ends is responsible for the settled sand in such classifiers breaking away, unless the reduced load has been noticed and the underflow adjusted accordingly. On another mine a ball suspended centrally in the classifier has proved its merits by steadying the underflow and permits the depth of settled sand being kept at a low level in the classifier consistent with a low ratio of moisture in the underflow.

Where a diaphragm classifier is used as a separator of sand from slime, an automatically regulating underflow ought to be welcomed. There may be objections to the same idea for tube-mill classifiers, but I think that it is better to underfeed a tube mill and allow for its taking an increased load rather than have constant conditions in the classifier underflow and coarse sand overflowing the classifier without the tube mill having been tried on the increased load.

Instead of diluting a thick underflow after its leaving the classifier, a good plan is to have a stream of water just below the diaphragm. The necessary moisture for tube milling can thus be added inside the classifier from a one-inch pipe attached to a rubber hose and water service. The required moisture for the underflow is then regulated from a valve, and the pipe can be lowered or raised to the most suitable height. The nozzle can be reduced to one and a quarter inches diameter, and the underflow is discharged at a high velocity. On one mine this method has proved very satisfactory, more so than adding water to the discharged pulp.

Changes in the feed and moisture entering large conical classifiers under working conditions sometimes cause sand to bank up in these classifiers, thereby forming a "dead end" and decreasing the capacity of the cones available for classification. This is particularly noticeable where a tube-mill plant is working at fullest capacity and giving a medium-grade overflow from the classifiers of about 15 per cent. plus 60 grade pulp, or the equivalent to that which would pass a 1,200-mesh screen in single-stage crushing. On the other hand, however, where a fine overflow is desired of about 5 per cent. plus 60 grade, and under, the tube-mill classifier is encroaching upon the provinces of a separator of sand from slime, for which it is an ideal machine, and no appreciable "dead end" is formed. This depends to a great extent on the number of tube mills to stamps and the ratio of solids to moisture leaving the stamps. Of course, sand held in suspension in classifiers can be prevented by increasing the size of the underflow, but as far as tube milling is concerned, classification of pulp is the sorting into a limited tonnage of that portion of pulp desired for recrushing, and in that respect I have sometimes been puzzled to see where classification came in at all when between 400 and 450 tons of solids constituted the average feed per tube mill. These large tonnages are claimed to give the best results on some plants, while on others a tube-mill feed not exceeding 300 tons gives the best results. Where amalgamation is not practised in the stamp mill, nor in the classifier overflow, the larger the feed to the tube mills the greater the percentage of gold recovered by amalgamation in the tube-mill circuit.

In order to overcome the difficulty of fine sand resettling and silting up classifiers, the classifier designed by Mr. H. Stadler is undoubtedly an improvement on the ordinary cone. At the bottom of the central feed-pipe to this classifier the area of the cone is greatest, so as to allow settlement of the solids from the level of release of the pulp into the classifier. From that point, having sorted out that portion of solids required in the underflow, by means of a truncated cone, the velocity of the upward stream is gradually increased, thereby preventing "dead ends," which otherwise are formed in the ordinary cone by the decreasing velocity of the upward stream.

A cone centrally fed and having a horizontal baffle on the bottom of the feed pipe does not give an even distribution of feed into the cone. In order to see this, however, the cone has to be working at fullest capacity. Further air is carried down the feed pipe into the cone, and it rises to the surface in the form of air bubbles, bringing coarse sand with it, which, if near the overflow lip and not confronted with a baffle, causes coarse sand to pass in into the overflow. Some mines employ a sleeve around the feed pipe to catch the air bubbles. On the grounds that if no air was carried into the liquid none could arise to the surface, the writer placed an iron plate partly over an eight-inch feed pipe to a diaphragm classifier. The conditions allowed a twenty-inch "head" being obtained over the feed pipe. No air was then carried down, and the overflow level of the classifier was free from air or other disturbances. The feed to the classifier was increased, still keeping the twenty-inch head, and it was seen that the distribution of feed to the cone was not even, thereby causing at intervals upward currents of coarse sand which were free from air. In order to get better distribution into the cone and still prevent air from getting into the classifier, a better method was to maintain the "head" from the bottom of the feed pipe. Mr. C. W. Dowsett then applied a self-regulating device which consisted of a circular plate, seven inches in diameter, with three lugs projecting upwards. These lugs acted as guides when the plate rested on the horizontal baffle at the bottom of the feed pipe. This plate was then suspended from a bolt which went to the top of the launder, and was attached to a horizontal piece of wood two inches wide, half an inch thick, and six feet long. One end of the wood was made fast to the top of the launder, while the other end suspended the bolt carrying the lugged plate. With a normal feed, the lugged plate was about one inch above the horizontal baffle, and a head was obtained from this point up to twenty inches above the inlet of the pipe. As the feed increased, the lugged plate was forced downwards, thereby increasing the release area of the feed pipe and allowing a greater feed to pass into the classifier. Similarly, as the feed decreased, the lugged plate rose and the "head" remained constant within certain limits. Owing, however, to the limited area of the cone at the bottom of the feed pipe and the increased velocity of the feed caused by maintaining the "head" already referred to, together with a slight unevenness in the distribution of pulp into the cone, the tendency is for settled sand to be disturbed, thereby causing upward currents of coarse sand. The distributing shoe used in the Stadler classifier would appear to overcome this difficulty, and

even though air may be carried down the pipe, it is in a fine state of division in the classifier and classification is not retarded by its presence.

A change from one classification system to another does not mean that finer overflows are to be obtained by the new classifier. If, however, the assay value of the overflow has been reduced by the new system of classification, then it can be safely said that improved classification has been obtained.

The swirl of pulp from centrifugal motion of the shoes in a grinding pan causes the surface of the liquid to keep a concave shape, and the particles of sand, on being crushed, rise in the liquid, the tendency being for these fine particles to be forced to the periphery of the pan. In order to obtain advantage of this classification, the discharge of such pans should be from the perimeter. This is easily understood, but not always realised, because the Holman grinding pan, which was tested on the Rand five years ago, did not prove a success, a contributory factor to its failure being that the discharge of the pan was upon a wrong principle. This pan had a peripheral inflow and central discharge through a perforated reversed cone. The design of the pan necessitated a peripheral feed, but that was no reason for a central discharge, which was fundamentally wrong. The discharge could advantageously have been placed on the perimeter opposite the inflow.

Two elevations of pulp are often required in new milling plant. There is no occasion, however, for the two elevations of pulp for purely classification purposes, because the stamp-mill pulp and tube-mill pulp can be kept separate with only one elevation of pulp. The best classification of pulp is obtained where these products are kept separate, but this is only marked where medium-grade overflows of about 15 per cent plus 60 grade pulp is desired. The tendency is for new milling plants to produce about 60 per cent. slime, and in that case classification of pulp is almost a separation of sand from slime, and it is doubtful if any improvement in classification by keeping the stamp-mill pulp and tube-mill pulp separate by double pumping would be offset by the cost of the second elevation of pulp. Mixing nine-mesh products and tube-mill outflows in the same classifier is wrong in principle, because different sizes of particles have different velocities, as pointed out by Mr. R. Boss,* and the tendency in hydraulic classification with mixed feeds is for the light material to follow in the path of the coarser particles. Put to a practical test Mr. Boss's observations, but instead of dropping pebbles into the same glass vessel, have two vessels. Procure fine particles of quartz and particles of pyrite of equal volume, and note their difference in the time for settlement in separate vessels. Also test mixed feeds in one vessel. The only conclusion the careful observer can arrive at is that, in order to get the best results in classification, each grade should be sized and fed to a separate classifier. When this proposition becomes economical, it will be possible to obtain from separate overflows products which, after dewatering, contain neither pyrite nor gold. It is, of course, possible with present methods of classification to obtain a plus 60 grade product which contains but little pyrite or gold, as recently pointed out by Mr. H. Stadler in a rather spirited article, "The New Metallurgy," which appeared in the "Rand Daily Mail." Only a very limited percentage of the total ore crushed could be obtained of this class. It is apparent, however, that while development takes place in the cheapening of the means of ore crushing whereby the sand is separated to be then slimed, there is still a wide field for research in hydraulic classification. No metallurgist will then want to cyanide barren sand.

* See "Segration of Solids in Liquid," Mining and Scientific Press, September 9th, 1911.

RAND MINING IN PICTURE



Smelting Room at the Crown Mines



A New Automatic Extraction Process

Catalytic Force of Aluminium, Electric Earth-Currents and Ultra-violet Sun-rays Utilised for Extracting Precious and other Metallic Solutions
New Automatic Process and Plant

By PROFESSOR GASTON JACQUIER, B.Sc.
(Patentee, 1910)

THE following details relate to the treatment of zinc-sulphate, copper-sulphate, and arsenic-sulphide solutions. In 1911 there were approximately five thousand tons of metallic zinc actually thrown away by the combined mines of the Transvaal and Rhodesia.

Fifteen Per Cent. of the Gold Mined is Irrecoverably Lost.

"The South African Mining Journal," in the issue of June 15th, 1912, has published a very interesting article entitled, "Ore Reserves, Grade, and Recoveries," in which the author says: "As a general rule, it may be said that, with the best metallurgical appliances extant, a recovery of not more than from eighty to ninety per cent. of the assay value in the mine can be expected. In other words, if the average assay value of the stope blocks on a milling width is ten dwts. per ton, an actual extraction of not more than eight and a half dwts. is in general practice obtained." The statistics published by the same journal for 1911 show that 8,251,240 ounces of gold were recovered from the reef mined on the Rand, the assays showing 9,764,700 ounces of gold, so some 1,513,460 ounces of gold, to the average value of £6,000,000, are irrecoverably lost.

This shows how essential an economical process is for the recovery of a portion of this lost gold, as well as the recovery of the zinc, from the solutions at present running to waste on the mines of the Rand and other places. This also applies to silver. The solutions of zinc-sulphate are recognised by the leading metallurgists of the Rand to contain only 0.33 dwts. of gold and seven per cent. of zinc per ton.

Messrs. Forbes Julian and Edgar Smart, in their book, "Cyaniding Gold and Silver Ores," a practical treatise on the cyanide process (page 168) say: "There is always a certain amount of unavoidable loss in cleaning up and smelting, and it is difficult, if not impossible, to determine what that is. Some authorities put the minimum loss as low as 0.1 per cent., while others maintain that one per cent. is nearer the mark."

Mr. Francis L. Bosqui, Ph.B., the well-known metallurgist and expert in cyanide work, in his book entitled "Practical Notes on Cyanide Process (New York, 1904) says: "Losses.—Following table indicates the value in dollars per ton of gold and silver left in the first hot-water dilution after successive stages of settling:—

	Gold.	Silver.	Total.
	$	$	$
First hour ...	0.41	0.04	0.45
Second hour ...	0.20	0.04	0.24
Third hour ...	trace	trace	—

A total loss of $0.69, or in English currency of nearly three shillings per ton of solution after settling. I would call attention to the fact that not one expert or author mentions the number of tons of solution in which a ton of metallic zinc transformed in sulphate is dissolved, a point most necessary in order to establish the quantity of gold and silver lost in each clean-up. Mr. Francis Bosqui alone mentions the silver, and not one author alludes to the zinc, nor the gold dissolved in the form of salt which cannot be obtained by settling. For treating such apparently poor solutions only a cheap process could have any commercial value. There are well-known processes which have been tried for this purpose, but not one extracted separately the gold from the zinc salt, and all were unsuccessful, some on account of their using chemicals, others through being uneconomical.

I will now prove that the process* of which I give the description below is the only one known which can work sufficiently economically to ensure a commercial success.

Could all the gold contained in the solution be extracted by settling alone? Yes, if it were totally in suspension in a free state, but this is not the case. The gold dissolved in the form of salt cannot be obtained at all by settling. This explains the reason why I have always extracted more gold by my process than was recognised. Mr. A. Heyman, analytical and consulting chemist and metallurgist, of Johannesburg, has certified that from a solution from the Meyer and Charlton Gold Mining Company 0.82 dwt. of gold per ton was extracted by my process. The gold value of the solution was considered by the company's consulting metallurgist as abnormal, as it had been taken out of a vat which had been used for a number of years and where a certain amount of concentration had taken place. I think that a solution in which a settling has

*The same process and plant can be utilised with very little modification for gold chloride and nitrate, silver-chloride and nitrate, copper-chloride acetate-nitrate, lead-chloride acetate-nitrate, thallium-chloride, and other metallic solutions. In the last cited instance a slight loss of aluminium is met with.

taken place for a number of years would contain contrariwise less free gold in suspension than a new one. The Randfontein Central have extracted 0.96 dwt. of gold per ton of solution by my process. The solution was a new one and was assaying 1.3 dwts. after a complete analysis. The trial was made from a tank containing five hundred tons.

The time is approaching when the single cyanide treatment for the extraction of gold will be employed exclusively all along the Rand. Then more than twice the quantity of zinc now used will be necessary, even if the zinc dust process be adopted, because the quantity of tons of cyanide solution to be treated will be more than doubled.

Mr. Francis L. Bosqui, in his book cited above, says: "Imperfect precipitation may result in clean-up discrepancies by allowing too great values to pass in working solutions. This source of gold loss, however, is not apt to be overlooked in a well-conducted mill." If fifteen per cent. of the gold mined is not recovered, that proves that some source of the gold loss is overlooked, which, by my process, can be recovered.

Plant. (According to Drawing.)

The plant consists of (1) a collecting tank of a size proportionate to the number of tons of solution poured after each clean up; (2) several small tanks in concrete or wood, 0.60c. in depth, two metres in width, and a length proportionate to the quantity treated; (3) wooden frames on which aluminium sheets, 60c. × 100c., are suspended; (4) false bottoms in aluminium 2m. × 2m. broad; (5) strainers lined with aluminium 2m. × 2m. broad; (6) funnels lined with aluminium of same size as the strainers; (7) railings for moving the strainers, false bottoms and wooden frames from one tank to another; (8) pulleys on wheels for lowering and raising the apparatus above; (9) taps on each tank to drain off the exhaust solution; (10) aluminium sheets, 60c. × 100c. and 2mm. thick, suspended from the frames at equal distances of about 50c.—the sheets can easily be removed from the frame to be scraped; (11) glass shed covering the small tanks; (12) revolving brushes for scraping the aluminium sheets.

Cost of Plant.

The cost of the plant, as drawn above, is very small. It consists of ordinary tanks in concrete or wood (lined with aluminium sheets) of a size proportionate to the quantity of solution treated. Hot water being employed in the dilution, the number of tons of solution per ton of zinc will amount to about twelve instead of forty with cold water. The aluminium sheets, being of 2mm. thickness, are not expensive at the present price of the metal.

Working Expenses.

The working expenses are nominal. The process requiring no power, no chemicals, and being automatic, demands no skilled labour. It can be managed by the cyanide staff. It has been proved that there is no loss of aluminium during the process.

How the Process is Worked.

For zinc-sulphate, copper-sulphate, arsenic-sulphide solutions, etc.: (1) The hot solution having been collected in the large tank, must be treated immediately after each clean up; (2) the false bottoms are lowered into the precipitating tanks; (3) the solution is poured through the strainer into each tank to be aerated; (4) the aluminium sheets frames are put in position exposed to the sunlight; (5) it must be verified by compass every day that the aluminium sheets are at right angles with the magnetic needle.

Precipitation of the Precious Metals.

(1) In twenty-four hours, more or less, if there is sunlight, all the gold and silver contained in dissolution are precipitated on the aluminium sheets in a pure state; (2) the aluminium sheet frames are raised and carried along the rail into a shelter, where the precious metals are scraped from the sheets after they have been loosened; (3) after the aluminium sheets have been cleaned up, they are again fixed to the frames and lowered into the tanks.

Precipitation of the Zinc or Copper, etc.

(1) After three or four days, more or less according to whether very hot or lukewarm water has been employed, the zinc or copper deposited on the aluminium sheets in a white and chemically pure crystal; (2) the aluminium sheets are carried out and all the zinc or copper scraped off; (3) the exhausted solution having been taken out, the false bottoms are raised, and any gold which has been deposited by settling, together with other metals contained in the solution, is taken out and treated separately.

Three Objections have been made Against My New Process.

(1) That on account of the price of aluminium compared to zinc it cannot be a commercial success.—As there is no loss of aluminium, I cannot understand how the price of aluminium can affect the economy of my process.

(2) That the zinc was obtained by evaporation and not by precipitation.—How, when a salt is dissolved in a hot solution and cooled, is the salt thus reformed obtained by evaporation? It is by concentration and not by evaporation.

(3) That as there are other well-known processes for the recovery of gold from these solutions, there is nothing to be gained by a trial of the process in question.—Then why is not the best of such known processes in use on the mines?

Probable Theoretic Explanation of the Mechanism of the Process.

In the process three natural forces are used: (1) The catalytic force of aluminium. This metal, like platinum and others, has the property of inducing certain chemical changes by its mere presence under suitable conditions, without apparently being affected itself. This is the property which explains why there is no loss of aluminium. (2) The chemical force of the ultra-violet sun's rays, called photolyse. It is a well-known fact that ultra-violet rays have the same effect upon a salt solution as has a current of electricity, namely, to decompose the solution. They produce a very energetic oxydising action. These properties are now utilised in some industries in Europe. (3) The electrical force of the earth current. This force, which puts in action the needle of the compass, has not yet been very well explained, particularly in presence of aluminium. Madame Curie herself cannot give an explanation, as you will read below.

How the Process Works.

By the catalytic force of aluminium the gold, silver, lead, zinc, copper, thallium, etc., are precipitated from their alkaline solution. By the photolyse the solution is decomposed. The water of the solution is decomposed; instead, however, of the hydrogen and the oxygen passing off as gases, the hydrogen alone is liberated to form H_2S, while the oxygen remains to form hydrogen peroxide, H_2O_2, and for this reason it is absolutely necessary that the plant should be exposed to the sun. By the electrical force of the earth's current, the precious metals contained in the solution are precipitated first on the aluminium sheets, as in an ordinary electrolitic bath containing different metals in dissolution; the aluminium being used as cathode. This is the reason that as soon as the gold is deposited it must be removed; the deposit of the other metals beginning after.

Having written to Madame Curie, Professor at the Faculte des Sciences de Paris, to ask her if the radio-activity played a part in my process, or if she considered that the theory I advanced above was plausible, I received the following reply :—

Paris, June 1st, 1912.

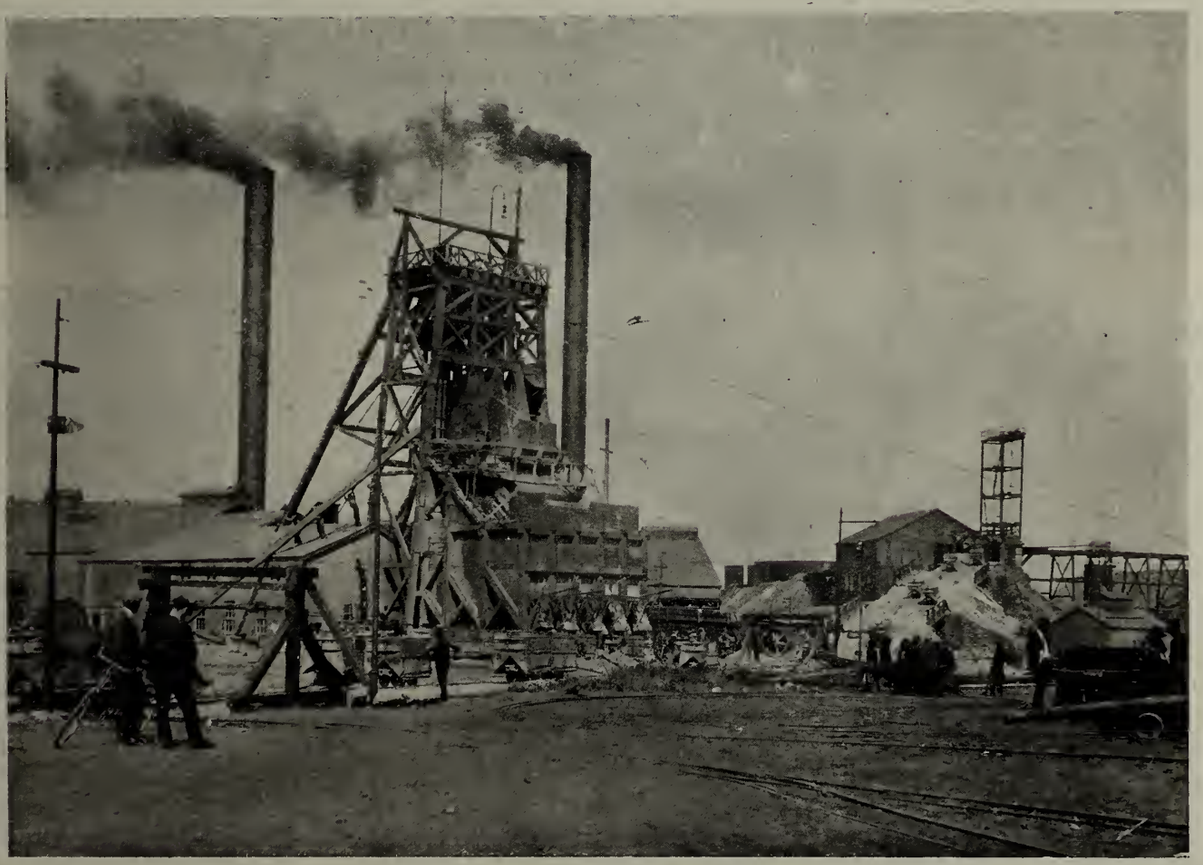
Your process of gold precipitation appeared to me very remarkable, and the hypothesis that you suggest on the subject seems to me correct. I think also that the aluminium must act as a reducing agent, and that the precipitation is produced by the simultaneous action of the aluminium and the sun's rays. In regard to the action of the orientation of the plant, I cannot yet give you an explanation.

M. Curie.

Approximate Losses of Gold and Zinc in the Zinc Sulphate Solution by each Group of the Gold Mines of the Rand.

Group.	Zinc. (Metallic used.) tons.	Zinc (Salt recovered.) tons.	Value of Zinc Salt per ton. £	Gold ozs.	Value. £	Total loss. £
Central Mining ..	1,200	3,600	28,000	3,000	12,000	40,800
Gold Fields	763	2,289	18,312	1,900	7,600	25,912
Randfontein Central and Langlaage ...	725	2,175	17,400	1,810	7,240	24,640
East Rand	600	1,800	14,400	1,500	6,000	20,400
General Mining ..	380	1,140	9,120	950	3,800	12,920
Neumann	360	1,080	8,640	900	3,600	12,240
Barnato	370	1,110	8,880	925	3,700	12,580
A. Goerz & Co. ...	168	504	4,032	420	1,680	5,712
Cons. Mines Selection	132	396	3,168	330	1,320	4,488
Kleinfontein Group	122	366	2,928	305	1,220	4,148
	4,820			12,040		163,040

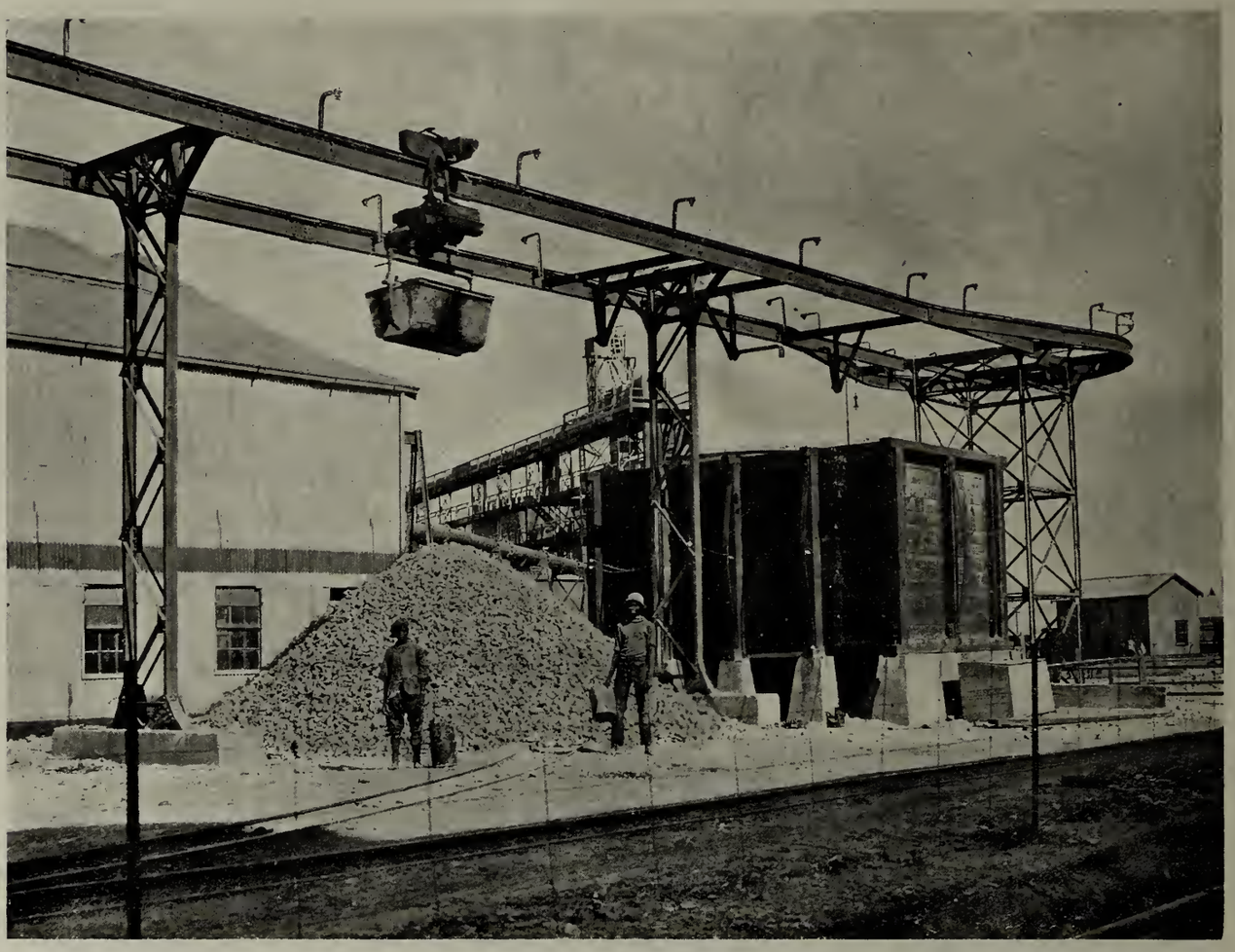
RAND MINING IN PICTURE



A Crown Mines Shaft with Mechanical Haulage

Automatic Transport of Pebbles

(See opposite page)





Some Views of Bleichert Automatic Transport Track

Automatic Transport of Pebbles

FOR the first time on the Rand, the Randfontein Central Gold Mining Company have employed a new means of transport for their pebbles to the tube mills; namely, the electric telpher car, which is used chiefly in Europe and America for the automatic transport of coal and coke in gas works, boiler houses, and the like.

The biggest installation of this kind is, we understand, working in Sydney, Australia, at the producing plant of the Australian Gas Light Company, where on four different levels suspension rails of a total length of about three miles and over, one hundred telpher cars are serving for the transport of coal and coke. Such dimensions are not required, of course, on the Rand, but we mention them in order to show that this means of transport, with its flexibility, deserves more attention than it has had up to now. With us the chief advantage is to be sought in the fact that at Randfontein, for example, not more than two natives for loading the buckets from underneath the crusher bins and one operator are required, and will be required even if the plant were extended to a length considerably bigger than the present one. The cars dump their contents automatically into the receiving bins near the tube mills along the line.

This plant has been supplied by the inventors, Messrs. Ad. Bleichert and Co., of Leipzig and London, and consists of a number of small cars driven by electric motors which travel automatically in succession on a closed track forming one self-contained circuit. A perfectly automatic "block" system is attained by arranging the overhead current-conducting wire, from which the cars obtain current by means of a sliding current taker, into isolated sections fed from the main cable through the switches at the ends of such sections. In passing, the switches are shifted by the cars themselves in such a manner that there is always a section without current between two successive cars on which any car, having got into a too close proximity with the preceding one, must come to a standstill. It is only after the preceding car has travelled over a certain length of the line, and after it has turned the first switch of the next block section which it is about to enter, that current is again restored to the first-mentioned



A Bleichert Automatic Transport Plant at Randfontein

block section, which has held up the car following behind. Thus correct spacing is automatically attained throughout the service and without the aid of workmen.

A few yards from the loading point, each newly arriving empty car stops automatically and waits until the preceding car has been loaded and despatched. Only then it moves up to the loading point, and this movement is continued down the whole line of waiting cars, each of them moving up one block section. The same applies in general to switch-rails and rail-crossings on this system, which are safeguarded in the same manner, as the car first arriving in front of switch-rail or rail-crossing cuts off the current from the adjoining sections, so that no other car can move on before the preceding one is at a safe distance. The loading of the car-buckets is effected quite simply. Each telpher car stopping at the loading-place near the crusher house remains motionless with the empty bucket suspended in the air until the operator turns the lever of the controller to lower the bucket down on to a low narrow-gauge rail truck, which is then pushed by two natives over a short distance of five or six yards towards the chute of the bin, where the bucket is filled and again attached to the hooks of the telpher car, hoisted, and sent off on its way to the pebble bins at the tube mills. Of considerable interest is the electric winch-gear suspended from the telpher car. This gear consists of two hoisting barrels, the lifting motor of about four to five horse power, and a controller which is operated from any convenient place near the loading point. All that is left to the operator is, first, to start the down motion which is stopped automatically on the bucket reaching the ground level, and then to initiate the lifting motion after the empty bucket has been replaced by a full one. The lifting motion is subsequently also stopped quite automatically as soon as the highest position is reached, and is also automatically converted into travelling, so that practically all the attention of the operator is only required by what is going on on the ground, while the cars take care of themselves for the remainder of the work.

A few more data with regard to the Randfontein plant may interest the reader. The total length of the track is about two thousand two hundred feet, the hoisting height about sixteen feet. The average travelling speed of the cars does not exceed two hundred and forty feet per minute, while the hoisting speed averages six inches per second. The capacity of one bucket is seventeen and a half hundredweights, and the hourly capacity of the whole installation is thirteen tons of pebbles. The total consumption of electric current has been figured out to be about 0.15 units per ton conveyed, including losses due to friction, etc.

Speaking generally, we think that the plants on similar lines which are at present under contemplation, and to which the Randfontein Central Gold Mining Company have set the example, will prove to be amongst those many labour-saving appliances which we must install in the near future to come nearer to the solution of the labour problem.

The main advantages we find in the telpher system consist of the two facts that on our mines the available ground area can be relieved of some of the traffic by making use of the room overhead and that another cheap working arrangement has been added to those already in use, which easily adapts itself to almost any existing local conditions.

RAND MINING IN PICTURE



South Rand Headgear, Crown Mines

Geology of the Witwatersrand

Results of Dr. MELLOR'S Investigations

A Composite Section of the Lower Witwatersrand :: A Valuable and Interesting Paper

WE take the following notes and sections from a very lengthy and most important paper which was prepared by Dr. Mellor, of the Geological Survey, for the Geological Society of South Africa.

Particulars of Beds Included in the Normal Section of the Central Rand.

NOTE.—The initial letters refer to the composite section (p. 84) and also to the Witpoortje section (p. 197). The figures in brackets represent approximate estimated thicknesses in feet; where based upon a special locality its name is also given.

The terms "shales," "sandstones," etc., used in the descriptions refer to the appearance and condition of the rocks as seen at the surface or in shallow prospecting works, since such descriptions are most likely to be of general use. In depth the arenaceous beds are, of course, practically all quartzites, usually bluish or greenish grey in colour, and the argillaceous beds generally hard dark blue or greenish rocks in which slaty cleavage is frequently but not universally developed. Nearly all the argillaceous beds show a tendency in places to more sandy types with a corresponding change of the individual laminæ into beds, sometimes of considerable thickness. The term "ferruginous" has been used in many descriptions in place of the term "magnetic," frequently applied to some of the Witwatersrand shales. The test often applied to such beds, viz., their capacity for affecting a compass needle, is very misleading, as this property may be markedly shown by, or entirely absent in the same beds, at different points along the strike, or even in the same outcrop, and a large proportion of the shales show this property to some degree. The term "magnetite shales" would be better, but the frequent conversion of magnetite into hematite in outcrops renders this term also inapplicable in many cases.

A. Orange Grove Quartzites.—Comprise several bands of quartzite separated from each other by shaly or schistose beds. The main group of hard quartzites which form the prominent ridge and escarpment of the Witwatersrand overlooking the granite area includes the quartzites a^1, a^2, a^3, while the quartzites included under A_2 form a subsidiary group with much less prominent outcrops, separated in the Johannesburg area from the main body by a considerable interval occupied largely by a diabasic intrusion. West of Newlands and Claremont the quartzites of A_2 come much nearer the main body.

a^1. Very hard, yellowish white quartzite, fine grained, compact and brittle, sometimes glassy (forty feet, Orange Grove).

a^2. The largest continuous body of quartzite (one hundred and eighty feet, Orange Grove), usually forming the crest of the ridge.

a^3. Yellowish white quartzite, similar to a^1, fine to medium grained, very hard and compact (twenty feet, Orange Grove).

A2. Consist of a group of four or five harder bands of quartzite, yellowish white or occasionally brownish, fine to medium grained, alternating with much softer, easily weathered, fine-grained sericitic and schistose portions inclining to sandy shales. It takes no part in the formation of the main escarpment north of Johannesburg, but has a very marked outcrop in Parktown West and Melville, where it forms a conspicuous ridge. Well developed also at Houghton Estate, Observatory, and Bellevue. (Two hundred feet, Observatory, inclusive of shaly bands.)



Ferreira's Camp, Johannesburg, in 1887

B. Water Tower Slates.—Usually rather hard, shaly, slaty, and flaggy beds, reddish or brownish black, very ferruginous, especially one band which usually forms a very conspicuous outcrop, as at the Water Towers in Parktown. (Eight hundred feet, Observatory.)

C. Ripple-marked Quartzite.—Very hard quartzite, greenish grey on fresh surfaces; usually not more than twenty feet.

D. Red Shales.—Moderately soft slaty shales, dark red in colour, easily weathered. Usually occupy lowest ground between Orange Grove and Hospital Hill quartzites. (Seven hundred and fifty feet, Observatory.)

E. Speckled Bed.—A thin band of medium to coarse-grained quartzite, often containing a fair proportion of felspathic material, becoming an arkose. (Thickness, four to five feet.)

F. Hospital Hill Slates.—For the most part rather hard slaty or flaggy beds, reddish, purplish, or brownish black in colour. Usually somewhat ferruginous and markedly so towards the lowest portion about the Contorted Bed f, a zone of conspicuously banded, hard, very fine-grained, flaggy, siliceous, or jaspery-looking beds, alternately poor and very rich in ferruginous material, mainly magnetite. Also include moderately thick beds of very fine-grained quartzitic character, rich in iron. (Seven hundred feet, Observatory.)

G. Very dark, rather soft, usually much-weathered shales. Often bluish or purplish black when exposed. Similar in general character to some of those below the Hospital Hill quartzites, and like them frequently ferruginous, especially G_2, which is sometimes also banded or striped, and then resembles the striped portion of Hospital Hill slates. (G_1 four hundred feet, G_2 one hundred feet, Brixton.)

H. Hospital Hill or Green Quartzites.—A series of three thick bands of quartzites alternating with shales. Frequently tinged with pale green, especially on bedding planes. Fine to medium grained. Grains often well rounded, especially in occasional coarser bands, and then often clear and set in an opaque fine-grained matrix, giving rise to the appearance locally known as "sago structure." The coarser bands increase in frequency and in size of constituent grains upwards in the series.

H_1. The lowest of the three bands mentioned above, average thickness about six hundred feet. "Sago" bands rare. About one hundred feet at bottom inclined to thin bedded and flaggy structure, passing gradually into the shales below. In several localities shows a wash of small pebbles scattered through one of the quartzite beds in the lower portion of the band.

H_2. Similar to H_1, but not so fine-grained and with more frequent sago bands. Average thickness, four hundred and fifty feet.

H_3. Similar to H_1 and H_2, but coarser. "Sago" bands very frequent, especially towards the top, and very coarse with well-rounded grains. (Average thickness, three hundred feet, Florida, Witpoortje.) Quartzites H^2 and H^3 inconspicuous or not visible in the Johannesburg section, but well seen from Brixton westwards.

J. Promise Reef Beds.—A succession of beds showing comparatively rapid alternations as compared with the beds below, from fine-grained and shaly to coarse and pebbly types, and also considerable variation when followed along the strike. Include a large proportion of fine-grained sericitic shaly sandstones, easily weathered and falling rapidly to pieces when exposed at the surface. With these are associated thin, narrow bands of shale, sometimes hard and ferruginous, while similar hard, ferruginous shales resembling G_2, and alternating with softer red shales attain a considerable thickness at the base of the group (j^1). The Promise Reef beds also include bands of coarse hard quartzites, one of which carries large scattered pebbles, sometimes exceeding three inches in diameter. A very persistent feature is the occurrence among the lower beds (see section) of the pebble-bed known as the Promise Reef (j^2), consisting of pebbles, usually small, but ranging up to two inches in length, a large proportion consisting of fine-grained quartzite. Higher up in the series (about one hundred and twenty feet, near Witpoortje) is the horizon characterised by the occasional occurrence of very large pebbles mentioned above (j^3), sometimes locally spoken of as the "Stable Reef," from a supposed correspondence with the reef of that name at Rietfontein. Associated with the "Stable Reef" is one known as the "Red Reef," similar in character to the Promise Reef, but more intermittent in character. The upper portion of the Promise Reef beds includes a band of hard white quartzites, about two hundred feet thick (j^4), which forms on the east side of the gorge a somewhat



Opening up the Ferreira Gold Mine

prominent ridge bearing a single beacon. The uppermost portion of the Promise Reef beds (j^5) consists of a hard band of red slaty shale, which is often seen at the surface and which is succeeded by the large body of quartzites which forms the lower portion of the next group. (One thousand eight hundred and fifty feet, Hamburg; one thousand one hundred and fifty feet, Witpoortje.)

K1. Lower Coronation Quartzite.—Moderately hard, usually yellowish-white quartzite, mainly coarse-grained, with numerous very coarse grit bands, becoming in places small-pebbled "bankets." (Eight hundred and twenty feet, Hamburg; four hundred feet, Witpoortje.)

K2. Coronation Reef Quartzite.—Outcrop usually intermittent. Coarse, gritty, or pebbly bands usually frequent in lowest portion, and most marked a few inches from the base of the quartzite—"North Coronation Reef." (Six hundred feet, Hamburg; two hundred and eighty feet, Witpoortje; three hundred and sixty feet, Barrett's, Rietfontein.)

L. Coronation Shales.—A series of flaggy, shaly beds passing up into highly ferruginous sandstones and shales. (Aggregate thickness six hundred feet, Hamburg; four hundred and fifty feet, Witpoortje.)

l^1 dirty greenish or reddish quartzitic flaggy and shaly beds and soft sandy shales, easily weathered, rarely outcropping, but well exposed near Witpoortje, half-mile east of gorge; nearer the gorge associated with diabase.

l^3 Coronation Shale Proper (West Rand Shale).—Highly ferruginous, slaty shale, often with much magnetite, dark reddish purple, glistening, often banded and resembling the striped portion of the Hospital Hill slate, for which it is often mistaken. About eighty-five feet thick. Passes down by hard red shale into dark red soft ferruginous sandstones, often containing widely scattered pebbles, sometimes of large size (l^2).

M_1. A series of soft, easily weathered, rather ferruginous, usually reddish-brown shaly sandstones and shales. (Four hundred and eighty feet, Hamburg; two hundred and eighty feet, Hamburg; three hundred and thirty feet, Witpoortje.)

M_2. Government Reef Shale.—Foot-wall shale of Government Reef. Hard purplish-red slaty shale, lower portion inclined to sandy shales, middle portion usually softer with less tendency to appear at surface, upper portion harder, often slaty and more ferruginous. (Four hundred and fifty feet, Hamburg; three hundred and thirty feet, Witpoortje.)

M_3. Hard red ferruginous slaty shales. (One hundred and twenty feet, Hamburg; eighty feet, Witpoortje.)

N_1. Lower Government Quartzite.—(Three hundred feet, Hamburg; one hundred feet, Witpoortje.)

N_2. Government Reef Quartzite.—Hard, usually reddish quartzite, mainly rather coarse, with occasional fine-grained portions. Coarse gritty to pebbly bands often present, especially in lower portion. (Five hundred feet, Hamburg; one hundred and sixty-five feet, Witpoortje; three hundred and forty feet, Barrett's, Rietfontein.)

n^1. Government Reef.—Usually a well-defined "reef," forming the lowest portion of the Government Reef quartzite and lying directly on the shale below. Thickness from two feet or more down to a single line of pebbles. Pebbles well rounded, mostly of white quartz up to two inches diameter where reef is thick, as at Witpoortje. Well developed from north of Florida to Witpoortje and beyond. Becomes much thinner eastwards from Florida, but still present east of Johannesburg.

n^2. Government Reef Leader.—In addition to the Government Reef proper, bands of pebbles of similar type occur at higher horizons in the Government Reef quartzite, more especially in the lower portion. One of the more strongly developed and persistent of these is known as the Government Reef Leader. To the north of Florida and Roodepoort a well-developed pebble bed of this type occurs about one hundred and twenty feet above the base of the quartzite, and is frequently of larger size than the Government Reef itself.



Opening Up Eagle Nest Mine, Johannesburg, March, 1889

N_3. Upper Government Quartzite.—Moderately hard, rather massive, medium to rather coarse-grained quartzite, with occasional bands of grit. This quartzite usually forms the northern margin of the wide depression extending north of the Main Reef and is the highest of the big quartzites of the Lower Witwatersrand System which forms any conspicuous outcrop or surface feature. (Five hundred feet, Hamburg; four hundred feet, Witpoortje.)

O. Moderately hard, red, somewhat ferruginous, slaty shale. (Five hundred and fifty feet, Hamburg; three hundred and fifty feet, Witpoortje.)

P. Rather soft, yellowish, quartzitic sandstones. At Hamburg a small pebble band on foot. Outcrops incomplete and not prominent. (Two hundred feet, Hamburg.)

Q. Moderately hard, red, slaty shale. (Three hundred and fifty feet, Florida.)

R. Soft, rather coarse, yellowish, reddish, or purplish quartzitic sandstones. Outcrops rare. (Four hundred and fifty feet, Florida.)

S. Soft, sandy and shaly beds, mostly fine-grained.

T. Rather soft, red shales, passing up into fine-grained, soft sandstones, which grade in turn into the hard quartzites of the Red Bar.

Probable aggregate thickness O to T inclusive (Jeppe's Town beds), three hundred and seventy feet, Florida and Hamburg; two thousand feet, Witpoortje.

Sections.

Fig. 1.—Section at Witpoortje (p. 197) about one-third mile east of the Gorge.—The section extends from the base of the Hospital Hill quartzites to the Main Reef at Grey's mynpacht. The small letters refer to the description given. Dips: from H_1 to I^1, sixty degrees; I^1 to O, sixty degrees; O to T, fifty-five degrees; Main Reef, forty-five degrees.

Fig. 2.—Composite section (p. 84) of the Lower Witwatersrand System on the Central Rand.—For a description of the various beds indicated by letters see above. Dip throughout, seventy degrees.

The section is made up of portions based upon data obtained from localities where such portions are best seen and most likely to show the normal sequence. The portion from H_3 to N_3 inclusive represents the actual section found along a line forming the northward continuation of the west boundary of Hamburg township, about two miles west of Florida. From G_2 to H_1 the section is based upon a comparison of sections presented to the north of Hamburg and Florida and at various points eastwards to Brixton and westwards to Witpoortje. From F down to the granite the section is based upon data afforded by the northern suburbs of Johannesburg, more particularly Bellevue and Observatory townships. No reliable data with regard to this portion of the section are obtainable in the Florida area. From O upwards to the Main Reef the section is based partly on the conditions seen about Hamburg and Florida, and partly on data afforded by comparison with corresponding portions of the section in other localities. The dip of seventy degrees shown throughout the section is that prevailing along the Hamburg line, those portions of the section taken from other localities, or showing a different dip, being represented in their true thicknesses on a dip of seventy degrees in order to give a ready means of comparison of the various beds and of various portions of the section with one another by simple measurement.

What the South African Mines Buy

£14,070,291 Spent in 1911

A List of Stores Consumed by Mines in the Union of South Africa in the Year

The return of stores purchased for consumption by the mines of the Transvaal during the year 1911, is as follows:—

Classification.		Totals for the Transvaal. Weight or Quantity.	Value. £
Bags	value	—	16,688
Belting	,,	—	145,608
Bolts, Nuts, Washers, and Rivets.	lb.	4,198,090	47,918
Brattice Cloth*	value	—	528
* Figures for items marked with an asterisk are for the second half-year only.			
Bricks	,,	—	35,698
Candles	lb.	12,981,209	233,839
Carbide	,,	4,033,009	41,927
CASTINGS—			
(*a*) Brass	lb.	499,574	29,377
(*b*) Iron	,,	6,642,444	97,527
CEMENT—			
(*a*) Casks	No.	19,389	29,785
(*b*) Bags	,,	171,702	91,265
Chemicals and Assay Requisites	value	—	160,952
Coal-cutting Machines	No.	59	5,074
Coal-cutting Machine Spares*	value	—	1,830
COAL—			
(*a*) Smithy	tons	28,494	39,556
(*b*) Steam	,,	2,495,315	1,502,315
COKE—			
(*a*) Imported	,,	1,761	12,116
(*b*) Local	,,	1,989	6,071
Cyanide	lb.	11,610,323	482,072
Disinfectants	value	—	15,653
Electrical Machinery (as detailed in statement below)	,,	—	848,442
EXPLOSIVES—			
(a) Blasting Gelatine	cases	507,112	1,149,818
(*b*) Gelignite and Gelatine Dynamite	,,	180,628	308,565
(*c*) Dynamite No. 1	,,	2,548	3,376
(*d*) Dynamite No. 2 and Ligdyn	,,	55,710	70,922
(*e*) Other Explosives	,,	1,873	2,437
(*f*) Detonators	boxes	323,667	36,482
(*g*) Electric Detonators (or electric fuses)	No.	361,375	1,931
(*h*) Safety Fuse	coils	8,048,426	148,509
Fencing and Wire Netting	value	—	4,896
FODDER FOR STABLES—			
Bran, Chaff, Mealies, Forage, etc.	,,	—	34,099
Hosing (steam, suction, and rock-drill)	,,	—	69,768
Hand Tools (Picks, Shovels, Hammers, etc.)	,,	—	83,245
IRON—			
(*a*) Bar and Angle	lb.	10,982,512	88,565
(*b*) Galvanized	feet	1,609,067	35,149
(*c*) Sheet	lb.	398,741	3,627
Lamps and Spares*	value	—	11,953
LEAD—			
(*a*) Pig	lb.	158,227	1,516
(*b*) Sheet	,,	59,424	827
LIME—			
(*a*) White	bags	451,531	114,388
(*b*) Blue	,,	38,684	7,111
LUBRICANTS—			
(*a*) Oils	galls.	1,109,527	126,995
(*b*) Greasea nd Tallows	lb.	4,445,664	67,775
Machinery and Machine Tools (as detailed in statement below)	value	—	1,238,418
Mercury	bottles	3,258	29,640
Metals (Anti-friction)	lb.	286,076	23,945
Mill Screenings	value	—	31,921
Mill Spares	,,	—	118,376
FOODS, etc. (for coloured labourers)—			
(*a*) Beans and Rice	lb.	11,730,076	87,559
(*b*) Meal (Mealie, Kaffir Corn, etc.)	bags	613,287	324,575

Classification.		Totals for the Transvaal Weight or Quantity.	Value. £
FOODS (Continued)—			
(c) Malt and Cereals for Beer...	value	—	17,599
(d) Meat	lb.	31,136,950	471,658
(e) Salt	,,	1,248,817	2,266
(f) Groceries, Coffee, Sugar, Molasses, etc.	value	—	35,489
(g) Sundry Food, including bread	,,	—	131,562
(h) Vegetables	,,	—	47,456
(i) Medicines, etc.	,,	—	33,277
(j) Clothing	,,	—	20,209
Packing	lb.	479,423	47,858
Paint, Tar, Drying Oils, etc. ...	value	—	25,122
Paraffin	cases	45,041	25,693
Pipes and Pipe Fittings	value	—	453,392
Rails, Crossings, Sleepers, etc. ...	value	—	268,223
Rock Drills	No.	3,956	87,703
Rock Drill Spares	value	—	180,548
ROPES—			
(a) Wire	,,	—	119,159
(b) Cotton and Manilla ...	lb.	407,381	14,834
Screws, Nails, etc.	value	—	20,483
Shoes and Dies	lb.	15,216,830	137,533
Skips and Spares	value	—	23,386
Stationery	,,	—	61,132
STEEL—			
(a) Bar, Tool, Cast, etc. ...	lb.	2,540,859	31,925
(b) Sheet	,,	12,266,390	86,304
(c) Hand-drill	,,	5,096,060	76,174
(d) Rock-drill	,,	7,377,191	110,924
TIMBER—			
(a) Building Material (Ceilings, Floorings, Doors, etc.) ...	value	—	44,038
(b) Oregon, Pitch Pine, etc. ...	cub. ft.	1,651,992	313,674
(c) Mining Poles and Round Lagging	value	—	251,180
(d) Deals	feet	6,144,639	168,666
(e) Fuel	value	—	14,118
TUBE MILL REQUISITES—			
(a) Pebbles and Flints ...	,,	—	4,847
(b) Liners	sets	530	60,509
(c) Other Requisites	value	—	15,806
Trucks and Spares	,,	—	108,091
Washing Plant Spares*	,,	—	11,193
Waste	lb.	864,366	18,294
Water (purchased)	value	—	127,251
Zinc and Zinc Discs	lb.	9,573,807	158,047
Sundry Articles not specified above	value	—	456,621

The detailed statement of "Machinery and Machine Tools" and "Electrical Machinery" as shown (gross) in the above table is as follows:—

Classification.	Totals— Transvaal Mines. Value. £
MACHINERY AND MACHINE TOOLS—	
Water Purifiers	96
Boiler Plant, other than of Locomotives, Traction Engines or Steam Wagons	85,732
Headgear	48,349
Steam Engines—	
(a) For Winding	88,098
(b) For Pumping, including Pumps if directly driven	2,101
(c) For Compressors, including Compressors ...	82,834
(d) For generating electricity*	516
(e) For other purposes	5,081
Pumps—	
(a) Airdriven	7,829
(b) Driven indirectly by Steam...	5,353
(c) Driven indirectly by Electric Motors... ...	52,712
(d) Driven indirectly by Gas or Oil Engine ...	2,012
Steam Locomotives	14,426
Traction Engines	730
Steam Lorries	—
Motor Wagons—	
(a) Electric	—
(b) Oil	—
Gas or Oil Engines	19,193
Mechanical Lifts and Elevators other than Belt Conveyors and Elevators	7,868
Belt Conveyors and Elevators	36,177
Other Mechanical Haulage...	27,215
Reduction Plant, excluding Engines and Consumable Stores, such as Shoes and Dies, Screenings, etc. ...	255,380
Washing Plant*	6,104
Treatment Plant, including Furnaces	156,201
Workshop Plant, excluding Engines and Motors ...	21,624
Mine Ventilation Plant, excluding Engines, Compressors, and Motors	18,739
Diamond Drills (property of company)	497
Miscellaneous Machinery not particularised above ...	293,551
Total Value [shown under the heading "Machinery and Machine Tools" (Stores Consumed)] ...	£1,238,418

* Figures for items marked with an asterisk are for the second half-year only.

ELECTRICAL MACHINERY, including Fittings for Power and Lighting—	£
Electric Generators and Engines driving same if directly driven...	11,655
Electric Hoists, including Motors	322,479
Electric Locomotives	6,583
Electric Motors driving Pumps, including Pumps, if directly driven	42,277
Electric Motors, not included above...	87,355
Power Lines, Transformers, etc.	177,462
Miscellaneous Machinery not particularized above...	199,631
Total Value [shown under the heading "Electrical Machinery" (Stores Consumed)]	£848,442

The following table gives the total expenditure on mine stores in the Union for the year:—

		Gold Mining Industry.	Diamond Mines.	Coal Mines.	Base Mineral Mines.	Lime and Flint Works.	Total.
		Value. £	Value. £	Value. £	Value. £	Value. £	Value. £
Witwatersrand	£11,216,456						
Outside Witwatersrand...	436,868						
Total Gold Mines	£11,653,324						
Reef Diggers	26,909						
Metallurgical and Tailings Works	27,053						
Transvaal		11,707,286	271,219	276,071	152,259	53,446	12,460,281
Cape Colony		750	660,752	5,850	152,986	No record.	820,338
Orange Free State		285	518,156	43,968		362	562,771
Gold Mines	£3,367						
Reef Diggers	3,067						
Natal		6,434		218,893	585	989	226,901
Union of South Africa	£	11,714,755	1,450,127	544,782	305,830	54,797	14,070,291

A South African Invention

The Robeson-Bettington Boilers

THE Robeson-Bettington system of burning powdered coal in a boiler is now fairly well known to engineers all over the world. A few notes regarding the progress this invention has made in South Africa will probably be of interest to engineers in other mining centres.

The theoretical advantages of being able to burn powdered coal in the form of a jet or flame in a boiler



Robeson-Bettington Boiler in Course of Erection at Johannesburg Municipal Power Station

furnace, as is done at the present time with oil-fuel or gas, have been recognised by engineers for many years, but it is only since the experiments initiated on the Rand by Messrs. Robeson and Bettington, as long ago as 1900, that any practical progress has been made. At that time early experiments were made on ordinary boilers with special beehive ovens arranged in front, into which the mixture of air and powdered coal was blown by a fan. It was soon found that no material (even carborundum was tried later on) would resist the intense heat and corrosive action of the gases. There was also the difficulty of getting rid of the semi-liquid slag and particles of dust formed by the ash in the coal.

These early experiments, however, resulted in the establishment of certain principles which must be adhered to before the system could be successful. Some years later, Mr. C. A. Bettington conceived the idea of a long vertical furnace formed by a ring of tubes, the interstices of which were filled with fire bricks, thus forming a furnace in which the tube surfaces were protected by fire bricks, and in which the fire bricks themselves were prevented from getting excessively hot by the heat being carried away with the water in the tubes. The fuel mixture being blown vertically upwards into this furnace, the lower end could be formed into an ash-pit, into which the slag and dust settled in a form in which it would be easily removed. From this time the progress of the system has been very rapid. Two experimental boilers were built in England in 1907 to Mr. Bettington's designs, and these being practically a complete success from the very start, the manufacture and sale of these boilers was immediately commenced. In 1908 several of these boilers were installed in England at various centres, and early in 1909 the first Robeson-Bettington boiler was put to work on the Rand at the Bantjes Consolidated Mines. Subsequently, other boilers were installed on the Rand, at the Warren Hill Syndicate's mines, near Klerksdorp, also at the Crown Mines, and Jupiter Gold Mine, and at the De Beers Consolidated Mines at Kimberley. In one or two of the earlier installations considerable trouble was experienced owing to the peculiar natures of the local coals, and also owing to the rarified air at the altitude of the Rand, which is nearly six thousand feet above sea-level. A careful study of the various local conditions has, however, brought about the elimination of these early difficulties, and the latest plants have proved most successful in every way. In some of the plants that have been installed the boilers are under steam throughout the whole of the month, being only stopped down for a few hours each month for inspection; others, on mines where the load is very fluctuating, are run for only a few hours a day, the boilers being used in conjunction with others to take the peak load when the winders and air compressors are running at their full capacity. The quickness with which steam can be raised from cold water makes this type especially—one might say almost uniquely—suitable for such conditions, the boilers being very often on the mains within twenty minutes of the full jet being lighted, the boiler being practically cold to start with—this with a unit of three hundred horse-power on the centennial rating. The largest size is over one thousand horse-power and raises steam in under half-an-hour.

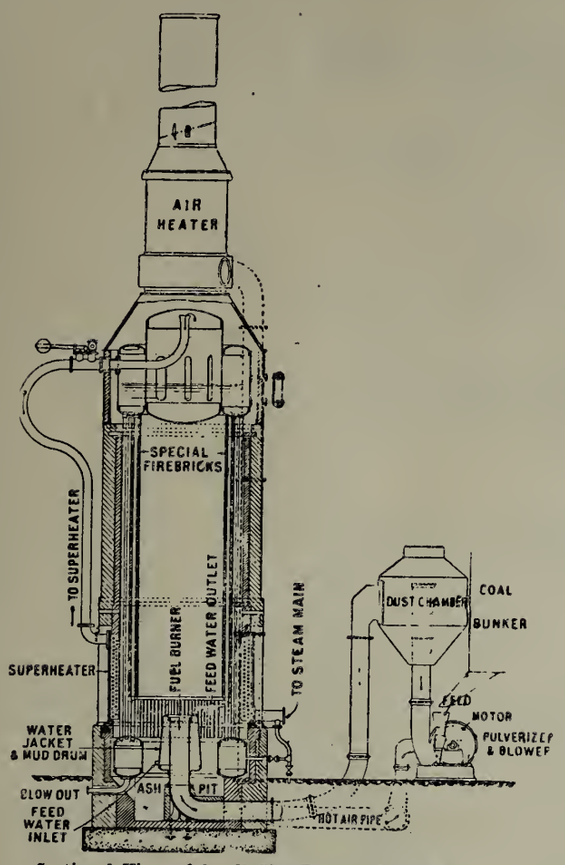
It has been unfortunate in the progress of this invention on the Rand that the huge electrical enterprises



Another View

now supplying power to the majority of the mines were started before the merits of the Robeson-Bettington boiler were fully appreciated, and, in fact, the opinion

has often been expressed that, had this boiler been developed a few years previously, there would have been no electric power companies on the Rand outside the municipalities. When one considers that the average stoker can run a battery of these boilers as easily as



Sectional View of Small Size Robeson-Bettington Boiler

he can the old hand-fired type of land boiler and maintain an efficiency throughout the day approximating to eighty per cent. in smaller sizes and considerably over in the larger sizes, and with only the assistance of one or two "boys" to attend to the ash haulage—the saving in expense of coal and labour must make a very considerable difference in the running expenses of the plant.

The quick starting and small stand-by losses in these boilers have been so clearly demonstrated on the mines that it was recently decided to instal a very large unit of over one thousand horse-power at the Johannesburg Municipal Power Station. This boiler has done exceedingly good work in taking peak loads during certain hours of the day, and in helping out sudden demands on the station such as occur during the heavy storms peculiar to the district. It appears probable that there is a big future for the Robeson-Bettington boiler in all types of power stations, especially where the load is a fluctuating one. We understand that recent tests on this particluar boiler show an efficiency of between eighty-two and eighty-three per cent. with an overload capacity of about fifty per cent., the overload rate of evaporation being obtained within a minute or two of the acceleration of the coal feed and air draught.

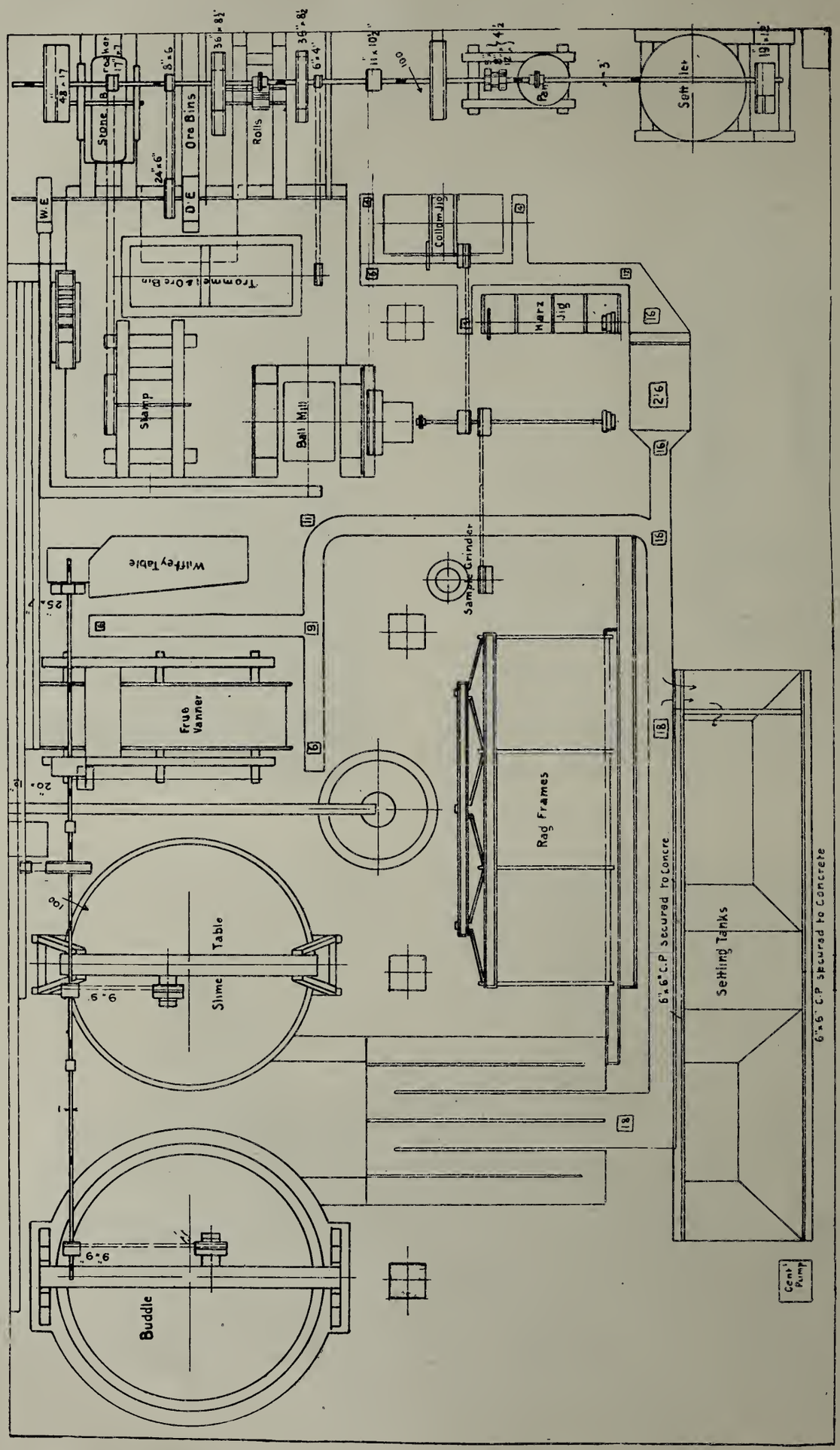
Concurrently with the progress on the Rand, we understand that further boilers have been installed in England and in Canada. Recent experiments in England have produced extraordinary results. The boiler experimented on is of the same size as the three hundred horse-power boilers installed on the Rand, and yet with special pulverising and fan arrangements an overload of as much as one hundred and thirty-one per cent.—that is, seven hundred horse-power—has been maintained for over an hour and a half without the slightest detriment to the boiler. It was very noticeable that, if anything, the efficiency rises at these overloads, the combustion being absolutely smokeless at all loads.

These boilers are at present made by the well-known firm of Messrs. Fraser and Chalmers, Ltd., of London and Johannesburg.

Note.—The inset illustration is of the one thousand horse-power boiler when in course of erection at the Johannesburg Municipal Power Station.



An Early Photo of the Cassel Colliery. Several well-known Randites are seen in the foreground



South African School of Mines: Plan of Experimental Ore Dressing Plant.

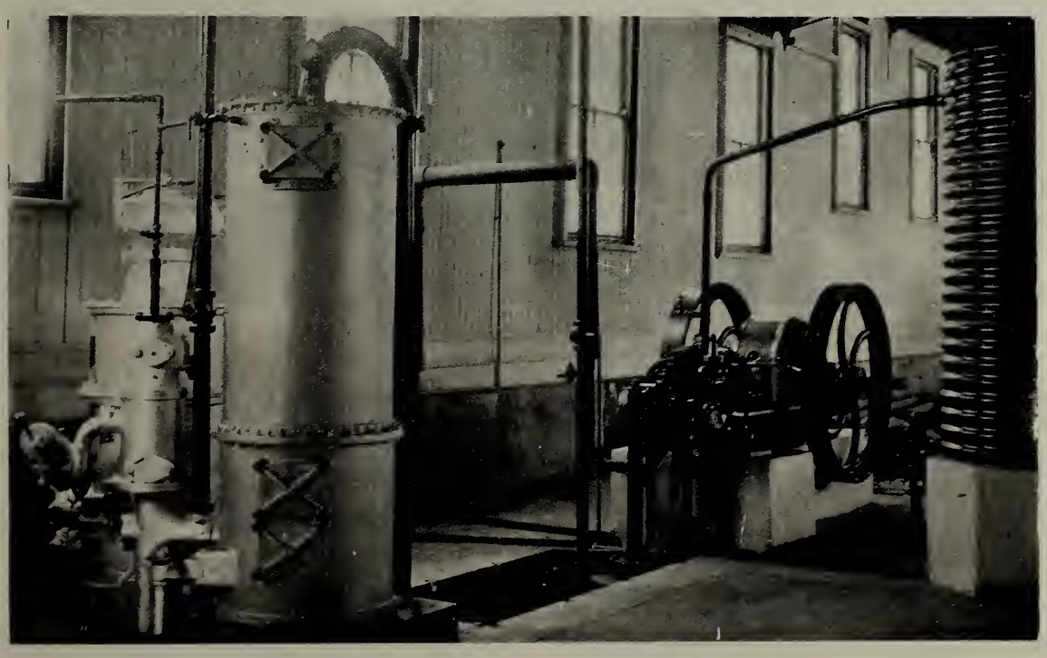
The South African School of Mines and Technology

By Professor G. H. STANLEY
(Professor of Metallurgy)

ONE of the most important features in connection with the life and work of an industrial community is the provision made for educating those to whom will fall the future technical direction of the several branches of activity. The Witwatersrand, in this respect, can lay claim to the possession of an institution which, both on the score of efficiency in instruction and adequacy of equipment, takes rank among the best in the Empire.

The first School of Mines in South Africa was established in Kimberley in 1896, its function being to provide, in conjunction with the South African College, Capetown, a complete course for the training of mining engineers in South Africa, leading to the degree of B.Sc. in mining engineering of the University of the Cape of Good Hope. Students attended at Capetown (and later also at the Victoria College, Stellenbosch) for the first two years of their course, and completed their training at Kimberley, some putting in a short while also in Johannesburg at practical mining. However, the original idea of working for the third year at Kimberley and the fourth at Johannesburg never came fully into operation.

Soon after the conclusion of the war, on the initiative of Mr. Sargent, Director of Education for the Transvaal and Orange Free State, and with the co-operation of the Witwatersrand Council of Education, a strong committee was formed of gentlemen identified chiefly with the technical side of the mining industry, to advise him in the matter of technical education, and this committee recommended the establishment of a technical institute of the highest kind, which should include all branches of engineering study. A conference was also held with representatives of the South African College and South African School of Mines, and as a result the necessity of providing instruction at Johannesburg in branches of technical education connected with mining was emphasised, especially in the interests of students taking the third and fourth year course for the examination of the University of the Cape of Good Hope.



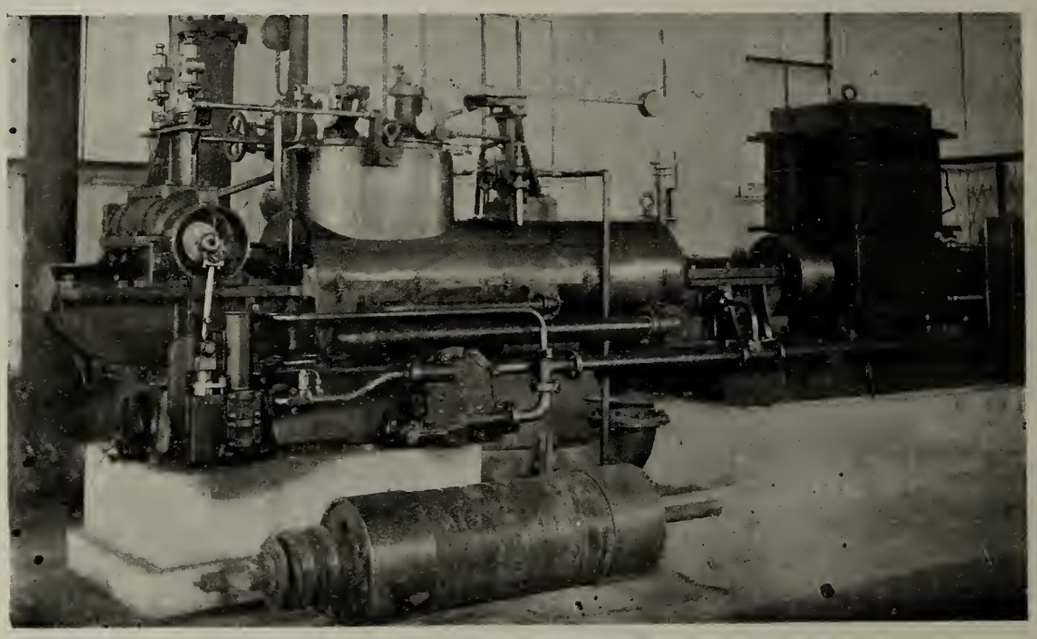
Engineering Laboratory—Suction Gas Engine

Meanwhile proposals were also put before the Government to make suitable provision for the housing of the bacteriological laboratory, for the establishment of a laboratory for research in connection with the hospital, and for the development of the Public Library. His Excellency the Lieutenant-Governor therefore appointed a Commission, in January, 1903, known as the "Technical Education Commission," to consider what steps should be taken to establish an institution which should form part of a teaching university, taking into account in connection therewith the latter proposals above-mentioned.

This Commission was fully representative of the local scientific and industrial world, and recommended in its

report, among other things, that temporary provision should at once be made for carrying on a four years' mining course, and that at the same time general technical and higher education should be provided for. Further, the recommendation was made that the Government should set aside Plein Square as a site for the establishment of a technical institution, which, in addition to the necessary laboratories, etc., should contain the Public Library and Museum, and afford accommodation for the various local scientific societies.

In accordance with these recommendations, the Transvaal Technical Institute was founded with a Council appointed by His Excellency the Lieutenant-Governor, which held its first meeting in September, 1903, and Plein Square was also set aside for the purposes set forth. Further, the work of the School of Mines at Kimberley was transferred, with the full agreement of all concerned, as it was felt that Johannesburg was the most suitable location. Temporary premises were taken, and work commenced in technical subjects in March, 1904, but as these premises were found to be quite unsuitable, a group of temporary buildings was erected on Plein Square to provide more suitable accommodation, pending the erection of permanent buildings.



Engineering Laboratory—Steam Turbine.

At the same time, the staff was increased and provision made for the teaching of arts subjects.

It was soon felt that the original title was no longer suitable, in view of the character of the work carried on, and consequently the name was changed in 1906 to Transvaal University College. Meanwhile negotiations were in progress with reference to the erection of permanent buildings ; for this purpose the Witwatersrand Council of Education donated £60,000, which, with £30,000 granted by Government, provided a building fund of £90,000. Competitive designs were then called for, the scheme ultimately accepted, that of Mr. R. Howden, of Johannesburg, providing for five distinct blocks or wings occupying the whole of Plein Square. The funds available allowed of the immediate erection of the first wing, and the foundation stone was laid by Lord Selborne in August, 1907 ; the formal opening taking place on March 9th, 1909.

In the meantime the work of the arts side had been transferred to Pretoria, though both the arts and technological branches were under the control of an enlarged Council, with local committees in Pretoria and Johannesburg respectively. Early in 1910, the two branches were separated by Act of Parliament, the Pretoria section carrying on the arts work under the title of the "Transvaal University College," and the Johannesburg section becoming the "South African School of Mines and Technology."

On the consummation of the Union of South Africa, the institution came under the control of the Union Parliament, its operations continuing to be directed by the Council appointed by the Governor under the Act of 1910.

The present members of Council are as follows : Dr. G. S. Corstorphine (Chairman), William Cullen, Colonel W. Dalrymple, Samuel Evans, Charles Glyn, H. J. Hofmeyr, R. N. Kotzé, Senator W. F. Lance, J. G. Lawn, Sir Thomas Price, K.C.M.G., Senator W. K. Tucker ; and W. E. Cursons (Secretary).

In addition, a Senate has been constituted to control academic matters and advise the Council as required. This consists of the professors as follows : G. R. Thompson (Chairman), H. G. Breijer, W. Buchanan, R. H. Charters, R. A. Lehfeldt, J. Colin Murray, John Orr, T. E. Robertson, G. H. Stanley, J. A. Wilkinson, and R. B. Young (Secretary).

The total permanent teaching staff numbers twenty-one professors and lecturers, and there are in addition about double this number of special teachers for evening classes, etc. The work carried on comprises both day and evening classes, both in Johannesburg and at other centres along the Reef. The number of students in attendance at present is about one hundred and thirty in the day classes and close on one thousand in the various evening classes. The day classes consist of courses leading to diplomas in (i.) mining, (ii.) mechanical and electrical engineering, (iii.) civil engineering, and (iv.) metallurgy, the diploma course in each case extending over four years. These courses were framed, and syllabuses drawn up, after very careful consideration of the courses pursued at other similar institutions in other parts of the world, and with due regard also to South African requirements.

The minimum age for admission is sixteen years, and students must possess a sound preliminary education evidenced by having passed the matriculation examination of the Cape University or an equivalent. The first year course is the same for all students, and comprises mathematics, applied mathematics, physics, chemistry, geology, mineralogy, and graphics, together with workshop practice.. In the second year specialisation begins to a small extent. Mining and metallurgical students take mathematics, applied mathematics, physics, chemistry, geology, mineralogy, graphics, and

engineering design and drawing; while mechanical and electrical engineering students take engineering, electrotechnics, and metallurgy in place of chemistry, geology, and mineralogy. In the third year specialisation becomes more pronounced, and still more so, of course, in the fourth or final year, the subjects taken being as follows: Third year.—Mining and metallurgical courses: Mining, metallurgy, assaying, surveying, geology and mineralogy or chemistry, engineering, electrotechnics, engineering design and drawing. Mechanical and electrical engineering courses: Mathematics, applied mathematics, electrotechnics, engineering, metallography, graphics, engineering design and drawing. Civil engineering course: mathematics, engineering, electrotechnics, surveying, graphics and design of structures, engineering design and drawing, civil engineering lectures.

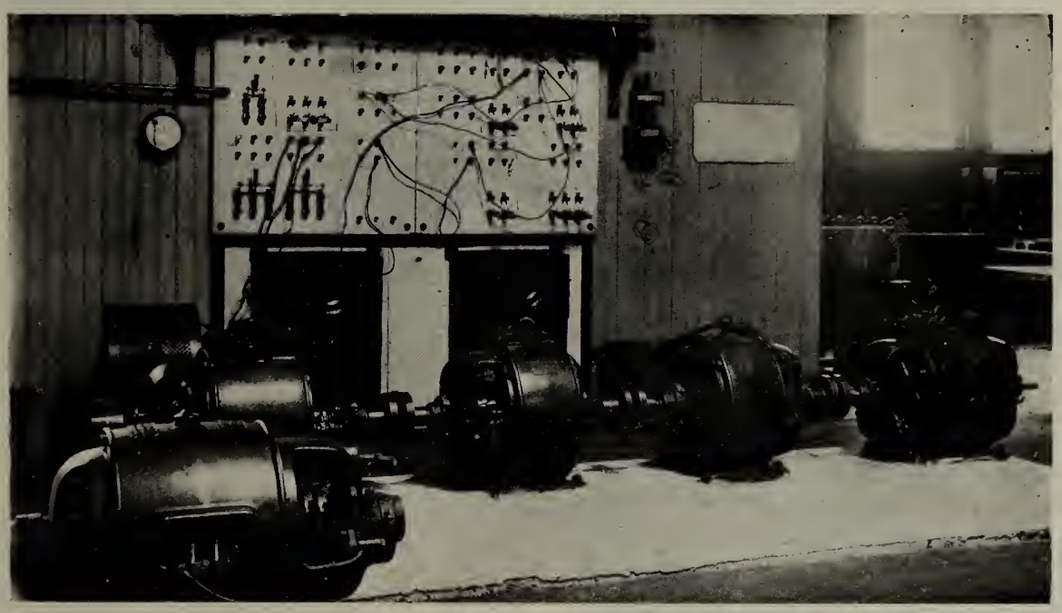
Fourth year.—Mining course: Mining, ore-dressing, surveying, assaying, metallurgy, engineering, electrotechnics. Metallurgical course: Metallurgy, Metallography, electro-metallurgy, assaying, ore-dressing, electrotechnics, engineering. Mechanical and electrical engineering course: Enginering, engineering design and drawing, electrotechnics, electrical design, electro-metallurgy. Civil engineering course: Surveying, engineering, engineering design and drawing, civil engineering.

In addition to these four year courses for the diploma, other courses are given in preparation for the Cape University examinations in land surveying, occupying two years; and in various branches of law in preparation for University and Civil Service examinations.

It will be seen, then, that the different subjects of instruction fall into the following departments: mathematics, chemistry, natural philosophy and physics, geology and mineralogy, engineering, civil engineering, mining, metallurgy and assaying, surveying, and law. Considering them in order, the professor of mathematics is Dr. H. G. Breijer, but, naturally, beyond the usual lecture rooms, no extensive equipment is here required. The department of chemistry is in charge of Professor J A. Wilkinson, and occupies part of the top floor. This department is entirely self-contained and equipped in very thorough manner. It comprises a lecture room, fitted up for the proper demonstration of lectures, with preparation room attached, balance room, elementary and advanced laboratories, store rooms, private room, etc. Complete courses are given in inorganic and organic chemistry, both theoretical and practical, and specialised courses for advanced students in such branches of chemical technology as the analysis and testing of chimney and mine gases, lubricants, explosives, water, etc.

Professor R. A. Lehfeldt is in charge of the department of natural philosophy and physics, located on the first floor. The work covers general physics, sound, light, heat, and electricity, so far as required by students of the several courses, special lectures being given for candidates for Cape B.A. and survey examinations. Here also complete provision is made for thorough instruction, a large main laboratory and several smaller advanced laboratories being provided, complete with workshop, private room, etc. Lectures are given in the large lecture theatre, designed specially for the meetings of scientific societies, and therefore excellently fitted for the purpose.

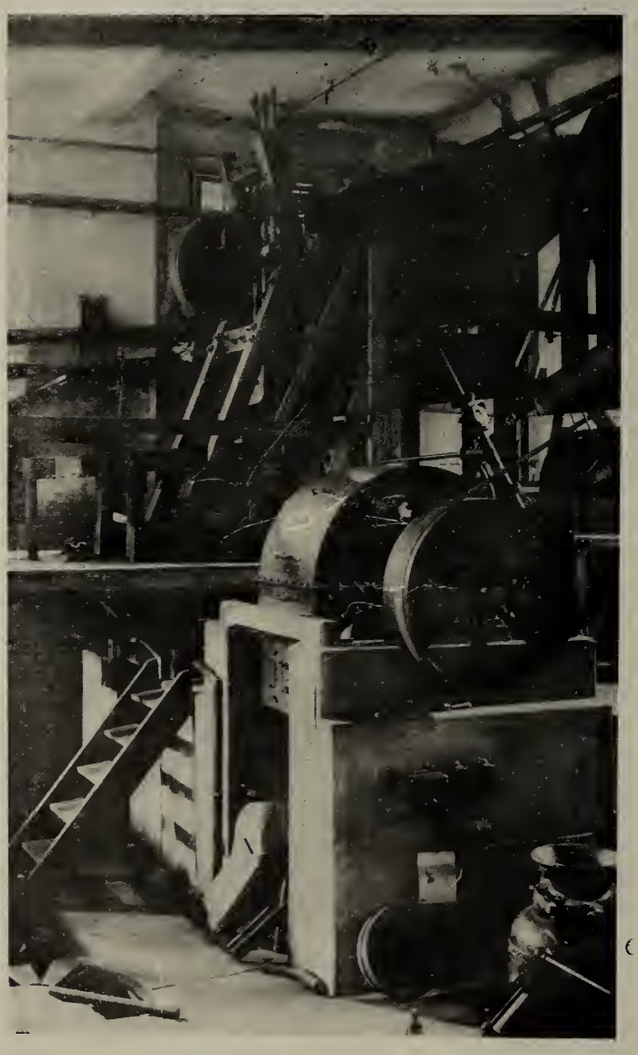
Next in order is geology and mineralogy, under the care of Professor R. B. Young, on the same floor as physics. At present only three rooms are available, these being the large geological laboratory, smaller advanced laboratory, and private room. The lecture courses cover dynamical geology, structural geology, crystallography, mineralogy, petrology, historical and economic geology. Lectures are illustrated by a comprehensive course in the laboratory and excursions to places of geological interest in the neighbourhood; students have the use of the college collection of rocks, minerals, and fossils, and have access to the geological collections of the Johannesburg Museum Committee, housed in the college buildings.



Electrotechnics Laboratory—Experimental Set.

Engineering is in charge of Professor J. Orr, and the lectures cover a very wide range, the subject being considered under the following heads: Materials of engineering, workshop practice, theory of machines and mechanism, mechanical transmission of power, prime movers, dynamics of machinery, strength of materials and theory of structures, heat engines, steam engine and boiler plants, internal combustion engines, hydraulics and hydraulic machinery, compressed air, pumps and pumping machinery, mining plants, winding plants, power plants and machinery regulations, economics of engineering. The department is fully equipped with workshops and laboratories, the equipment including Babcock and Wilcox water tube boiler, locomotive type boiler, Willan's double tandem compound engine of 80 i.h.p. (with surface condenser), Belliss' compound engine of 75 i.h.p. (with surface condenser), Tangye's vertical type steam engine of 20 i.h.p., Corliss engine, twelve inches by thirty inches, presented by S. Marks, Esq., compound Marshall engine, ten inches by sixteen inches by eighteen inches, presented by the Transvaal

Institute of Mechanical Engineers, vertical Hartmann engine, presented by the Victoria Falls and Transvaal Power Company, Ltd., Parson's steam turbine, coupled to 125 k.w. single-phase 2,000 volt generator, presented by the Rand Mines, Ltd., compound duplex air compressor, capable of supplying 120 cubic feet of free air per minute at a pressure of 100 lbs., presented by the Ingersoll-Rand Drill Company, internal combustion engine of 25 b.h.p., arranged to be run as a gas, heavy oil, or petrol engine, gas engine and suction gas producer plant, presented by the National Gas Engine Company, Ltd., twenty-ton crushing testing machine, 16-ton tensile testing machine, torsional tester, transverse tester, etc., cement testing apparatus, apparatus for the testing of oils, fuel and gas calorimeters, steam calorimeters, steam meter, steam engine indicators, gauge testers, and other apparatus for complete tests of heat engines. Through the courtesy of the Government Mines Department, students are permitted to use the Government Mechanical Laboratory, which contains a two hundred-ton Buckton testing machine, a fifty-ton Buckton testing machine, and various machines for testing wires, etc. The courses include the testing of the efficiency of various machines, experiments on friction, preparation of test specimens, tests of various metals in tension, compression, and shear; complete tests of other engineering materials: cement, concrete, bricks, building stones, timber, etc.; strength of beams, columns, chains, riveted joints, etc.; complete tests of



Ore Dressing Laboratory.

wire ropes, rope cappings, eac.; experiments on flow of water through orifices and over weirs. Students determine the indicated horse power, brake horse power, and mechanical efficiency of the various engines in the laboratory, and later make complete efficiency tests of boilers, steam engines, oil, gas, and petrol engines, air compressors, rock drills, and pumps. Students are required to prepare laboratory notebooks giving details of calibration of instruments used, methods adopted in carrying out the tests, sketches of plant and apparatus used and results obtained, so as to form a complete report of each test. The department also includes a large collection of models, apparatus, and machines, including a large model of a compound Robey engine, lent by Messrs. Robey and Co. The laboratory equipment is still housed in the old temporary buildings, but the lecture rooms and drawing office, etc., are in the new wing. The subjects of graphics and engineering design and drawing are also taken in this department.

Civil engineering is dealt with by Professor R. H. Charters, lectures being given on foundations, building construction, roads, sanitation and sewerage, heating and ventilation, roofs and steel structures, bridges, railways, water supply and irrigation, harbours and docks. The lectures are supplemented by office and field work.

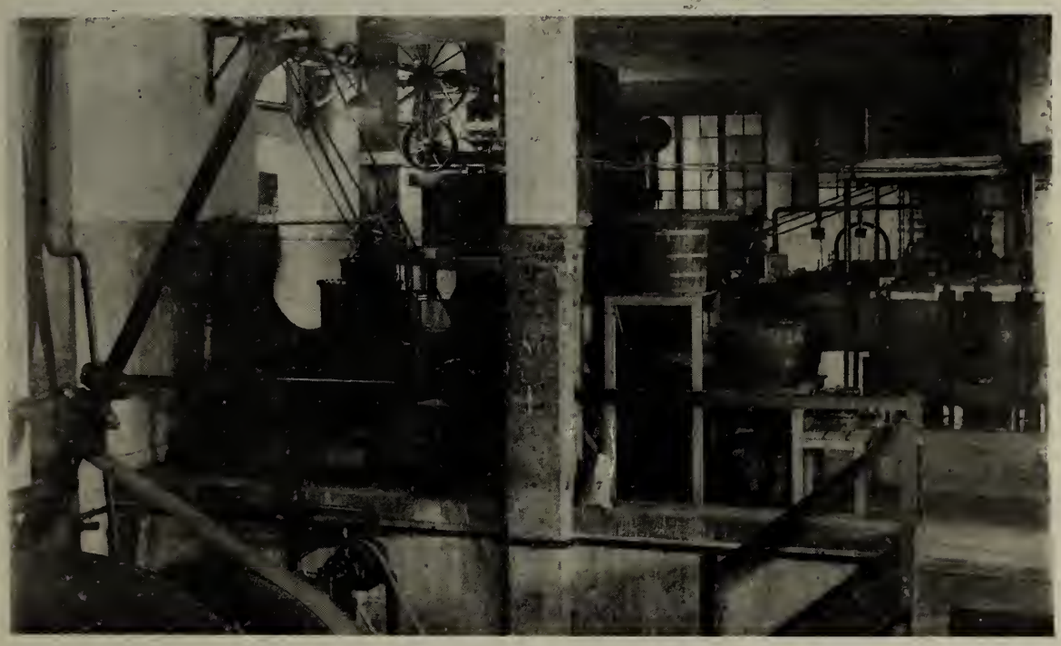
Professor W. Buchanan has charge of the department of electrotechnics, the subject being considered under the headings: Fundamental principles, magnetic phenomena, secondary cells, electric lamps and photometry, measuring instruments, direct current dynamos and motors, alternating electricity, electric light and power stations, electric traction, applications of electricity, design of dynamo-electric machines, telegraphy and telephony. The laboratory is well equipped, some extensive additions having recently been made for carrying out all the experiments outlined in the following courses:—Course I.: The calibration of steady deflecting mirror galvanometers, the calibration of ballistic galvanometers and simple measurement of capacity, complete measurements with the potentiometer and Kelvin balance, measurements of low and high resistances, complete tests of electricity meters, determination of flux per pole and magnetic leakage in a dynamo, measurements of permeability and hysteresis, experiments on continuous current dynamos and motors, determination of internal resistance, efficiency, and storage capacity of secondary cells, experiments on photometry. Course II.: Experiments on alternating current circuits and comparison with continuous current circuits, determination of power factor and wattless current, the oscillograph, experiments on electrical resonance, simple determination of values of inductance and capacity, experiments on alternators, including the study of synchronous motors, experiments on transformers and induction motors, the measurement of polyphase power, experiments with rotary converters, motor generators and boosters, the balancing of multiple wire systems of distribution. Course III.: Separation of losses in continuous and alternating current machinery, the study of special wave forms with the oscillograph, accurate measurements of capacity and inductance, complete tests of transformers, further experiments on alternators, synchronous motors and induction motors, experiments with lightning arresters, further tests on the balancing of multiple wire systems of distribution. In this department, too, the laboratories are in the old buildings, while the lecture room is shared with physics.

The Principal, Professor G. R. Thompson, is also head of the department of mining. The syllabus of lectures in mining covers: Occurrence of minerals, prospecting, deep boring, methods of working deposits, excavation, supporting excavations, excavation and support in difficult ground, transport underground, transport in shafts, hoisting, transport on surface, drainage, ventilation, and lighting. In mining economics, labour, accidents, sampling and ore valuation, mine accounts, legislation, etc., are taken up, and suitable time is allotted for classroom work in connection. In ore-dressing the syllabus covers classification according

to size, comminution, agglomeration, concentration, etc. The laboratory work will include the use of ore-dressing plant, testing fuse and explosives, testing mine air and safety lamps, and the study of rock drills. An ore dressing plant has been installed, and is available for experiments and the testing of parcels of ore. It includes the following crushing appliances: Blake stone breaker, crushing rolls, small stamp battery, Chilian mill, ball mill, grinding pan and settler, and sample grinders. The classifying appliances are a revolving trommel screen and hydraulic classifiers. The concentrating appliances are a four-compartment Hartz jig, a Collom jig, Wilfley table, Frue vanner, Evans' revolving table, slime frames, a strip and a buddle; also a magnetic separator and various small experimental appliances and machines. The use of the batea, pan, and vanning shovel will be taught in the laboratory, and students will carry out experiments in crushing, sampling, classifying, jigging, magnetic separation and various other dressing processes.

The department of metallurgy and assaying is in charge of Professor G. H. Stanley. The lectures in metallurgy deal with the materials and products of metallurgical processes, preparation and properties of metals and alloys, fuels, refractory materials, fluxes, slags, etc.; metallurgical processes, operations, and appliances, roasting, smelting, etc.; design and construction of furnaces and other metallurgical plant, metallurgical calculations, furnace efficiencies, and furnace charges, treatment and utilisation of furnace gases, metallurgical economics and statistics. The metallurgy of iron and steel, ferro-alloys, gold, silver, lead, copper, tin, zinc, mercury, and other commercial metals in detail. Advanced courses are also given on metallography and electro-metallurgy. The laboratory instruction in metallurgy is intended to impress upon the students the chief properties of the metals and to indicate the principles upon which metallurgical operations are conducted. The nature of the practical work is indicated below: Examination of fuel, determination of coke, ash, calorific power, etc.; pyrometry; examination of refractory materials, fire-clay, etc., effect of impurities; metals, examination of properties and effect of impurities; alloys, formation and properties; amalgams; cooling curves; metallography; slags and silicates, fluxes, scorification; electro-deposition and refining; oxidation, formation of oxides, calcination, cupellation; sulphides, formation; reduction, of oxides by carbon, sulphides by iron, and by reaction of sulphides with oxides and sulphates; liquation; smelting and wet treatment of ores by the experimental metallurgical plant, which comprises, in addition to crushing, grinding, and amalgamating machinery, leaching vats, agitation vats for air, pump, or paddle agitation, filter press and suction filter, chlorination barrel, reverberatory roasting and smelting furnaces, blast furnace, lead desilvering kettle, etc., also motor-generator and small electric furnaces, and electro-depositing vats. This equipment enables ores to be treated on an experimental scale by almost any known process, and the method best adapted to the treatment of an ore to be determined. Complete microscopic and photomicrographic apparatus, with appliances for cutting and polishing metal sections is also provided. Further, assaying and metallurgical analysis are fully treated, and all the metallurgical work is carefully controlled by assay or analysis of the materials employed and products obtained.

The departments of mining and metallurgy occupy the whole of the basement, the space being divided up as shown on the plan, and the accompanying photographs well illustrate the character of the equipment.



Main Metallurgical Laboratory.

Surveying, dealt with by Professor T. E. Robertson, has a convenient lecture room and drawing office on the top floor, and an extensive equipment of all necessary instruments.

The law classes are under the direction of Mr. J. Colin Murray, the several subjects being Roman-Dutch law, Roman law and notarial practice, criminal law and law of evidence, English law, the law of contracts and torts, statute law, notarial practice and conveyancing.

Throughout the technical work the courses have been designed to take the fullest possible advantage of the almost unique opportunities which the school enjoys owing to its situation right on the most important gold field of the world. Practical work is an essential part of the training, and with the cordial support and co-operation of the mining industry, not only do students obtain a thorough laboratory training in the various subjects at the school, but in the vacation they are received into the mines and works of the district as "learners," and thereby acquire each year several months of actual practical work, the importance of which can scarcely be over-estimated.

In addition, excursions are made to other centres, such as Kimberley and Witbank, and it follows that on the completion of their courses they are familiar with the conditions and practice of their future employment,

and therefore at a great advantage as compared with students who have been trained oversea. They are in consequence able to immediately secure remunerative positions, which, on their giving proof of ability, lead on rapidly to others of greater responsibility and emoluments.

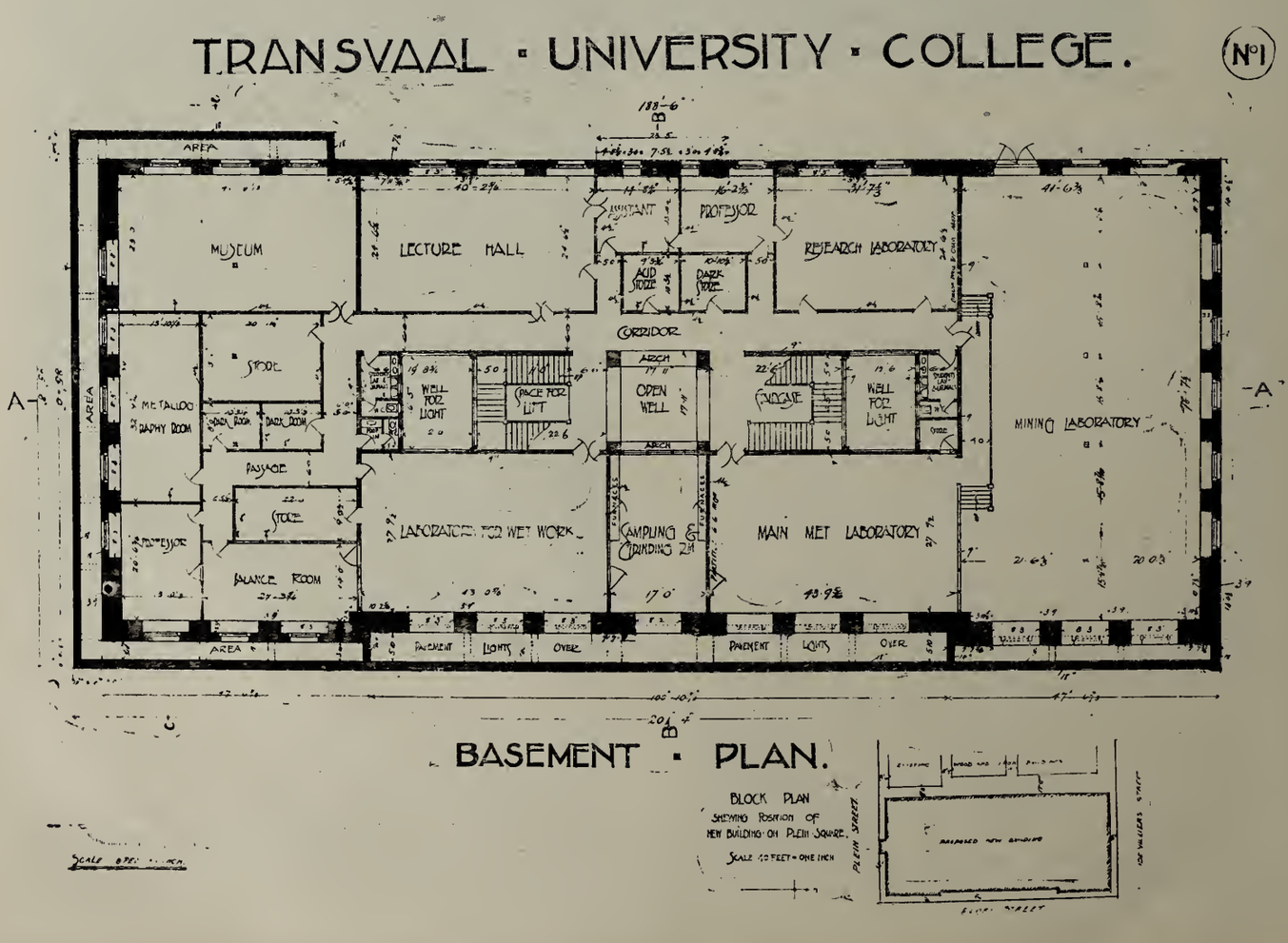
In order to admit of this practical work, the school session is divided into two terms of four months each, with a short break between, leaving over three months long vacation for practical employment.

In the engineering department it has been possible to still further extend the time spent in practical work, students of the last two years spending six months at college and six months in works, on what is known as the "sandwich" system, the time spent at college, under this arrangement, counting towards their apprenticeship. Engineers who realise the necessity of practical work will appreciate the advantage of this system. It is now recognised as the most suitable method of training students, although it has not been possible to adopt it at many institutions owing to the fact that the work is carried on in conjunction with arts and science courses, which do not require terms of practical work. Being a purely technological institution, the school is, therefore, fortunate in being able to adopt it.

The fees (£32 per year) do not differ greatly from those at oversea institutions, being even less in some cases, notwithstanding the high local costs, and as students come from all over South Africa, and even from oversea, a College House (the former residence of the



Assay Laboratory



Governor-General) has been provided as a residence, where also the fees (£60 per session) for board and residence are very moderate.

For the encouragement and reward of students, several valuable scholarships and bursaries are open for competition, the most important being the Chamber of Mines research scholarship of £250 for a year, to enable a selected student in mining or metallurgy to pursue research work. In this connection, it may be noted that the school laboratories may be utilised by competent persons for research purposes, full facilities being given. Besides the day work, to which the foregoing chiefly applies, the evening classes constitute an important part of the work of the school. On the Witwatersrand, as in other industrial districts, there exists a numerous class who, for financial or other reasons, have not taken a technical course of instruction before seeking employment. Being employed, however, in various capacities, many of them naturally desire instruction in the principles underlying their work, and in the theoretical side generally, and many also desire to study for the several Government examinations for certificates of competency. It is to supply this want that the evening classes are carried on, in many cases of just the same standard as the day classes. One difficulty met with, however, is the very varying standard of the preliminary education of the students, so that some special classes are in operation as a preliminary to others of a more advanced or specialised character. On the other hand, certain subjects which are not dealt with in the day classes, e.g., architecture, are provided in the evening. There is the further difficulty of the short time available for evening, as compared with day, work, which necessitates a student, if he requires a co-ordinated course at all comparable with a day course, attending over a number of years; and, further, there is the fact that in many cases working "on shift" prevents attendance. In spite of all these difficulties, as already stated, there are close upon one thousand evening students in attendance, which can only be regarded as extremely gratifying.

Although most of the classes are held in Johannesburg, where about six hundred and fifty students attend, for some subjects in which this course is possible, classes are held at other centres, i.e., Germiston, Benoni, Brakpan, East Rand, Kleinfontein, Van Ryn Deep, Krugersdorp, and Randfontein, thus enabling students to avoid the troublesome journey to town. In most cases, however, the equipment only available at the central institution is necessary. To obviate the trouble occasioned by having to "go on shift," certain of the classes are duplicated in the mornings or during the following week, and a student need not, therefore, miss a class. In these classes, also, prizes and scholarships are open for competition, the latter of £120 per year, presented by the Rand Mines, Crown Mines, Consolidated Gold Fields, and East Rand Proprietary Mines, to enable the best evening student of each year to take a full day diploma course.

Enough has been said to indicate clearly the nature of the facilities available and instruction provided by the school. The number of students in attendance, though not perhaps so large a proportion of the total number of employees as could be desired, testifies to the appreciation on their part of the opportunities afforded and already severely taxes the accommodation available; while the fact that graduated students obtain immediate employment, and in several cases have already attained to the management of mines, and to even higher positions, speaks for the appreciation of the mining industry.

OLD JOHANNESBURG



Telegraph Office in Johannesburg (Market Street) in 1887

The South African Engineering Standards Committee

Review of the History and Progress of the Standardisation Movement

By Professor JOHN ORR, B.Sc., M.I.C.E., etc.
(Professor of Engineering, South African School of Mines and Technology)

THE question of having definite standards acceptable and suitable to South Africa is one which from time to time during the past few years has received some attention. Of efforts made the most important were those initiated by the Transvaal Chamber of Mines, which in 1905 appointed a committee to consider the Standardisation of Machinery, Materials, etc.

The committee appointed eight sub-committees, with power to add to their number, to deal with the following sub-divisions :—

1. Pipes and Fittings.—Thickness and threads, external and internal diameters, etc.; also valves, flanges, and bolts and nuts—sizes and threads.
2. Shafting, Bearing Keys, etc., couplings and pulleys.
3. Mine Materials, track gauge, rail sections, transport switches, and crossings.
4. Mill Materials, shoes and dies, cams, tappets, screening, etc.
5. Building and Structural Material.—Wood, iron, and steel, mine timbers, etc.
6. Weights and Measures.
7. Glass Fittings used for Machinery, etc.
8. Makers' Specifications of Wire Ropes.

The programme outlined was an ambitious one, but for various reasons little came of the movement as far as the initiation of new standards for South Africa is concerned. A considerable amount of work was, however, done by the sub-committee for pipes and fittings. Messrs. Otto Lenz, J. F. Cook, and J. Berry were appointed by the Chamber of Mines as the sub-committee, with power to add to their number, and these gentlemen appointed Messrs. S. Sykes, W. H. Wood, and H. H. Johnston as additional members of the sub-committee. Messrs. J. D. Ellis (representing Stewart and Lloyds, Ltd.), F. K. Smith (representing U.S. Steel Products Company), and G. Ainsworth (representing H. Ainsworth) were also invited to attend the meetings to represent the manufacturers. At a later date Mr. J. A. Yule, of the Langlaagte Estate Gold Mining Company, was appointed in place of Mr. J. Berry, who resigned. Mr. W. Wilkinson was appointed secretary of the committee, and twenty meetings in all were held. The report was published in the sixteenth annual report of the Chamber of Mines (1905). This was accompanied by drawings and tables showing the proposed "Johannesburg" standard pipe threads, flanges, etc. In its report the sub-committee stated: "Our proposal does not coincide entirely with any of the existing standards, or with the proposed standard of the British Committee, because it is generally agreed that the existing British standard of threads is too fine for many sizes, while the American standard of threads is not altogether suitable. Referring to the British Standards Committee's new recommendation, we are of opinion that they have looked too much to manufacturers for information, and have not consulted users sufficiently." An effort was made to get the British Standards Committee to adopt the proposed Johannesburg standard, and Sir William Preece, one of their members, was deputed to meet the local committee. The subject was fully discussed with him, but the writer is informed by Mr. Lenz, who was chairman of the local committee, that the matter of introducing the British standard threads had advanced too far to permit of the subject being re-opened, so the whole question was dropped.

In view of the expressed intention of the Government to introduce a Weights and Measures Ordinance, the sub-committee (No. 6) appointed to deal with that subject decided not to take any steps in the meantime. At a later date, a Commission was appointed "to consider the draft Transvaal Weights and Measures Ordinance, and to report whether any amendments should be made thereon," and on this Commission the Chamber of Mines was represented.

The sub-committee on makers' specifications of wire ropes (No. 8) took no action, since it was considered that the Government Commission sitting at the time would in all likelihood go over much of the ground which the sub-committee was intended to cover.

A committee, consisting of Messrs. J. R. Williams, S. H. Pearce, G. O. Smart, Q. C. McMillan, R. G. Bevington, and W. A. Caldecott, all well known in the Rand metallurgical world and prominent members of the Council of the Chemical, Metallurgical and Mining Society of South Africa, was formed in June, 1906, on the standardisation of battery screening. Their report will be found in the proceedings of that society (vol. vi., 1906).

It is of some interest to note that as long ago as 1897 a committee of the same society investigated the question of differences of assays of bullion between the Rand and Europe, and, as one of the results of their deliberations, a standard method of melting, sampling, and assaying bullion was arrived at and published in vol. ii. of the Proceedings.

Mr. Martin Epton, at the time president of the Transvaal Institute of Mechanical Engineers, brought forward a definite suggestion in 1908 for a standardisation committee. The Institute took the matter in hand and voted funds for the initial expenses. An Executive Committee was formed constituted by representatives nominated by the following societies: The Transvaal Institute of Mechanical Engineers, the South African Association of Engineers, the Chemical, Metallurgical and Mining Society of South Africa, the Geological Society of South Africa, the Association of Transvaal Architects, and the Federation of Master Builders of South Africa. At a later date a representative of the newly-formed South African Institute of Electrical Engineers was added.

One of the principal objects originally kept in view was to consider the question as to how existing standard specifications for materials might have to be modified to suit the climatic conditions of South Africa, more particularly with regard to Portland cement, the manufacture of which has become an important colonial industry. The scope of the committee was subsequently extended, and in a circular letter to the leading engineers and architects in South Africa, asking for their co-operation, the objects of the committee were defined as:—

(1) To test the various engineering and building materials available in South Africa in order to arrive at standard specifications suitable and possible in South Africa.

(2) To consider and, where necessary, revise the British standard specifications for various materials.

It will thus be seen from the first of the objects mentioned that the committee has undertaken a work of very great magnitude and one of great national and industrial importance. South Africa being unfortunately not a manufacturing country, it has not been thought advisable to consider the question of interference with existing standards as far as manufactured articles, such as rolled joists, steel rails, etc., are concerned. But the investigation of the resources of South Africa, particularly with reference to its raw materials and products, is a subject which should interest everyone who has the successful development of this country at heart.

Fortunately the committee was able to enlist the sympathy of Sir (then Mr.) E. P. Solomon, Minister of Public Works in the late Transvaal Government, which gave the scheme its cordial approval and voted a sum of £100 towards the funds, at the same time nominating Mr. G. W. Herdman, of the Public Works Department, and Mr. J. A. Vaughan, Chief Inspector of Machinery, as members of the Executive Committee.

It is satisfactory to note that the mining houses have generously supported the movement, and, indeed, but for this support the work of the committee could not have been carried on. Up to date the following subscriptions have been received and so far the sum of nearly £300 has been spent. Donations:—

Transvaal Government	£100	0	0
Transvaal Institute of Mechanical Engineers	10	10	0
Association of Transvaal Architects ...	10	10	0
Pretoria Portland Cement Company ...	50	0	0
Johannesburg Consolidated Investment Co.	100	0	0
South African Association of Engineers ...	10	10	0
Johannesburg Brick and Potteries Company	10	10	0
Kleinfontein Group	50	0	0
Bloemfontein Corporation	5	5	0
Consolidated Gold Fields of South Africa ...	50	0	0
Rand Mines, Ltd.	100	0	0
De Beers Consolidated Mines, Ltd. ...	50	0	0
Transvaal Coal Owners' Association ...	25	0	0
	£572	5	0

It was originally hoped that the Union Government would support the attitude of the late Transvaal Government and assist the committee by giving a vote on the £ for £ principle. Many of the Government departments will undoubtedly benefit by the work being done, and in view of the fact that none of these departments is being asked to contribute to the funds, the committee hopes that a liberal donation may in the near future be received from the Union Government. Apart from printing and stationary, the main expenditure has been for the railway carriage of materials to be tested and for tests carried out in the Government laboratories, the full tariff in both these cases being paid.

When one thinks of the support given by the British Government to the Engineering Standards Committee, of the enormous amounts spent by the German Government in maintaining research laboratories and Government testing stations, and of the work done by America in such an institution as the Bureau of Standards at Washington, one feels that the committee may hopefully appeal to the Union Government for financial aid and encouragement. The following is an extract from one of the earliest reports of the British Engineering Standards Committee:—

"It soon became apparent that the movement was of such national importance that it was a matter which the Government ought to support, in view of the great advantage which would accrue from the committee's labours to the general trade of the country. With this object in view, the Main Committee approached the Government . . . . The committee was assured of the Government's entire sympathy and a grant of £3,000 for the year 1903-4 was made towards the necessary expenses."

Quoting from the seventh report of work accomplished (issued December, 1911): "The Government subsequently agreed to extend their financial support over the years 1904-5, 1905-6 by giving the committee a grant-in-aid equal to the amount contributed by the supporting institutions, manufacturers, and others, and they continued the grant on a smaller scale for the years 1906-7, 1907-8, and 1908-9. The Government have since consented to make an annual grant for the years 1910-11, 1911-12, and 1912-13, authorising the committee to make an application for its continuance at the end of that time. The Indian Government made a grant of £1,000 towards the general expenses of the committee in recognition of work done in the interests of that country. . . . The Indian Government has undertaken to defray the expenses incurred by the committee in the preparation of reports on subjects affecting India remitted to the committee, and has made further grants amounting to £800 in this connection."

The British Engineering Standards Committee is supported by the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Naval Architects, the Iron and Steel Institute, and the Institution of Electrical Engineers. Forty-three committees and sub-committees have been formed and fifty-seven publications dealing with engineering standards have so far been issued. In a letter recently received by the chairman of the South African Engineering Standards Committee, the secretary of the British Engineering Standards Committee says: "I should deem it a favour if you could advise me what subjects are being dealt with by the committee and whether my committee can be of any service to you in the work you are undertaking. I need hardly point out the desirability of close co-operation by the different parts of the Empire in a work of this nature."

It is unnecessary for the writer to elaborate on the importance of engineering standards as affecting the trade and industries of a country. Readers are referred to the two excellent addresses by Sir John Woofe Barry,

K.C.B., LL.D., F.R.S., chairman of the British Engineering Standards Committee, on "Standardisation and its Relation to the Trade of the Country," and by Professor W. C. Unwin, B.Sc., LL.D., F.R.S., on "Standardisation and its Influence on Engineering Industries."

A complete list of members of the committee is appended, together with the sub-committees which have been formed.

The Mechanical Tests Sub-Committee has considered that the materials which more urgently required investigation were the building materials of South Africa. The sub-committee has, therefore, set itself the task of testing the bricks, building stones, timber, etc., from the various parts of South Africa. Practically every brickyard in the Transvaal and Natal, in addition to other districts, has been visited and samples removed for testing. An effort is being made to classify the various kinds of bricks made into grades and to ascertain the strength and other properties of each grade so that in future it may be possible to specify bricks as definitely as any other material, such as cement. This work has already extended over two years; the magnitude of the work undertaken was not at first realised, but a report on the bricks of the Transvaal and Natal is in preparation, and it is hoped that a standard specification will be in the hands of engineers, architects, and builders at an early date.

Valuable work in connection with building stones has been done by Mr. Kynaston, Director of the Geological Survey, and by Dr. Corstorphine, consulting geologist. The committee hopes to follow this work up and make a series of mechanical and other tests of all stone suitable for building purposes.

In connection with the second object, outlined above, the sub-committee has been considering the British standard specification for Portland cement with regard to its suitability for general adoption in South Africa. A considerable amount of research work has also been done, particularly with a view to ascertaining how the tensile strength of cement is affected by the percentage of water used in making the briquettes. In this connection, an opportunity may be taken to recognise the assistance of the Johannesburg Municipality, which, in lieu of a donation, placed the services of its cement-testing expert at the disposal of the committee.

The Chemical Sub-Committee at its first meeting outlined the following programme of work as the most urgent warranting its attention:—

(1) General directions for sampling materials.
(2) Coal.
  (i.) Standard method of analysis.
  (ii.) Standard method for finding calorific value.
  (iii.) Standard specifications for coal supplies.
(3) Lime for cyaniding.
  (i.) Standard method of analysis.
  (ii.) Standard specification.
(4) Lime for building purposes.
  (i.) Standard method of analysis.
  (ii.) Standard specification.
(5) Lubricants.
(6) Paints and varnishes.
(7) Water: Standard for hardness, etc.

This sub-committee, of which Professor J. A. Wilkinson is chairman, has been particularly active, and two publications, the results of its work, have already been issued. These are as follows:—

(1) Standardisation of Coal Sampling.—This pamphlet deals with the standard methods to be followed in sampling coal under all conditions, including colliery sampling, ship sampling, bunker sampling, truck sampling—loading, in transit, unloading, and hopper truck—bag sampling, and the laboratory treatment of samples.

(2) Standardisation of Coal Analysis, Determination of Calorific Value, and Standardisation of Sizes of Coal.—This pamphlet deals with: The preparation of coal samples for transfer to laboratory, standardisation of proximate analysis of coal, standard treatment as regards moisture in coal, standardisation of determination of calorific value, definitions, etc., preparation of samples for bomb determinations, instrument and materials, details of process, and standardisation of calculation, and standard sizing of coal, with appendices on the sub-committee's experiments and on radiation formula. As stated in the preface:—

"All the parties in South Africa concerned in coal valuation have been consulted, and it is hoped that a satisfactory basis of agreement as regards standardisation has been reached, both as regards calorimetric work and the sizing of coal."

One thousand copies of each pamphlet have been printed and complimentary copies issued to all interested parties.

This sub-Committee is now engaged in considering standard tests and specification of lime for mine supplies.

The Electrical Sub-Committee has not yet done any formal work, but preliminary meetings and correspondence show a disposition to accept generally the British engineering standards which are largely followed in South Africa at present.

The committee is much indebted for donations in the forms of technical literature, engineering standard specifications, and results of research work obtained from the Bureau of Standards and the various technical societies in the United States of America and from the German Government, these having been received through the kind offices of the Hon. E. N. Gunsaulus, American Consul, and Herr Renner, Commercial Attache of the German Consulate at Johannesburg.

Much work still remains for the South African Engineering Standards Committee to do. It is sincerely to be hoped that such a useful movement will not be hampered for want of funds.

Members of General Committee.

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RAND MINING IN PICTURE



A Rand Tube Mill



Travelling Steam Crane on One of the Wharves, Lourenco Marques

The Coalfields of South Africa

Geological Sketch by ROWLAND GASCOYNE. M.Inst.M.E.

ONE of the most interesting features of the coal fields of South Africa is the striking similarity they bear to those of Australia, India, and South America, not only as regards their fossil fauna and ora, but likewise in the general character of their coal seams. On the other hand, they are so different in these respects from the coal fields of the Northern Hemisphere that the general opinion prevails that during the coal measure period of the Southern Hemisphere there existed a sea to the north, somewhere in the region of the present Sahara Desert, whilst India, Australia, South Africa, and South America probably formed one connected continent of land. This connection is shown by the discovery of fossils indicating the existence of similar types of plant and animal life throughout this old-time continent, one fossil fern, glossopteris, abounding in India, Australasia, and South Africa.

Then again, the coal seams of India, China, Japan, Australia, New Zealand, and South Africa possess many points of similarity in appearance and quality, and have quite distinct characteristics to those of Europe and North America, so that, from whatever aspect regarded, it seems difficult to escape the conclusion that South African coal fields are more closely related to those of other parts of the Southern Hemisphere than to those of Europe, North America, and other coal fields in the Northern Hemisphere.

Whilst geologists can discern striking similarities between the coal fields of South Africa and such distant fields as Australia and India, there seems to be, strange to say, some difficulty experienced in arriving at a definite conclusion as to the true geological relations existing between the different coal fields of South Africa.

The coal fields of South Africa belong to a collection of beds known as the Karroo system, so called on account of being characteristic of the Karroo district of the Cape, where they are also better developed than in any other Province of South Africa, for there they attain a probable thickness of at least 15,000 feet.

Comparative Table of the Karroo Formation and its Contemporary Foreign Equivalents.

South Africa.	Brazil.	India.	New South Wales.	Europe.
Stormberg Series. — Drakensberg Beds	Volcanic Rocks	Upper Gondwanas. — Rajmahal		Lower Jurassic
Stormberg Series. — Cave Sandstone	St. Bento Sandstone			
Stormberg Series. — Red Beds	St. Bento Series	Upper Gondwanas.		
Stormberg Series. — Molteno Beds		Kota-Maleri	Wianamatta Beds	Rhoetic
Beaufort Series. — Burgersdorp Beds	River Rasto Beds		Hawksbury Series	Trias
Beaufort Series. — Middle Beaufort Beds		Panchet		
Beaufort Series. — Lower Beaufort Beds	New Estrada Series	Damuda	Upper Coal Measures. — Newcastle	
Ecca. — Ecca Series		Lower Gondwanas.	Upper Coal Measures. — Dempsey	
			Upper Coal Measures. — Tomago	Permian
Dwyka Series. — Upper Shales	Iraty Shales		Lower Coal Measures. — Upper Marine Series	
Dwyka Series. — Boulder Beds	Pigeon Shales		Lower Coal Measures. — Greta Series	
	Pretty River Beds	Talcher		
	Orleans Conglomerate		Lower Coal Measures. — Lower Marine Series	Upper Carboniferous
	Sandstone Shales			
Lower Shales				

The Cape Geological Survey divide the Karroo system into the following series and divisions, as shown below, and, with slight modifications, this classification is generally accepted by all the leading geologists :—

Upper Karroo	Stormberg Series	Volcanic Beds. Cave Sandstones. Red Beds. Molteno Beds.
Middle Karroo	Beaufort Series	Zone of Theriodonts. Dicynodon Beds. Pareiasaurus Beds.

Lower Karroo	Ecca Series	Shales and Thin Sandstones.
		Laingsburg Beds.
		Shales.
	Dwyka Series	Upper Shales.
		Conglomerate.
		Lower Shales.

Space will not allow the various geological features of these beds to be dealt with, it being intended to deal with these so far as they concern the coal fields.

The opinion seems to be generally held that the only coal seams of any value yet discovered in the Cape Province belong to the horizon of the Molteno beds, and therefore belong to the Stormberg series. At first it was also considered that the coal seams of the Orange Free State, Transvaal, and Natal likewise belonged to that series, but on stratigraphical and palæontological grounds that view appears untenable.

The Molteno beds consist of different types of sandstone varying in structure from fine-grained to coarse grits and conglomerates. Where they carry the coal seams, it ought to be noted that shales abound, the coal seams, as a matter of fact, being as a rule interbedded in shales. So far the glossopteris fossil fern, so characteristic of the Orange Free State, Transvaal, and Natal coal fields, does not appear to have been found in the Cape Province coal fields. No workable seam of coal has yet been found in the Beaufort series of the Cape Colony, the thin coal beds found therein having been apparently derived from other beds and re-deposited in the Beaufort beds.

Now in the Transvaal and Orange Free State the Karroo beds have been but meagrely developed when compared with Cape Colony. The Dwyka conglomerate is present throughout the southern and eastern parts of the Transvaal, but the Ecca beds are very scantily represented in the Transvaal. They are, however, well represented in Natal and certain portions of the Free State, where they attain a good thickness. No workable coal seam has, however, been discovered in the Ecca beds in either the Cape or Natal Provinces despite their high state of development and the expenditure of thousands of pounds in prospecting for a payable seam of coal. It was in the Ecca beds on the Bluff at Durban that so much money was foolishly spent prospecting for coal a few years ago, whilst farther west, round Maritzburg, a good deal of expenditure has been also uselessly incurred in the same object. It is, perhaps, fortunate for the Transvaal, for these very reasons, that the Ecca beds do not exist in a high state of development there, because they contain such a large proportion of black shale and are so calculated to mislead the practical prospector for coal, that doubtless their presence would have led to the same foolish expenditure as has been the case in the Cape and Natal Provinces.

Whilst dealing with this subject, I must not forget to point out that Drs. Corstorphine and Hatch, in their work on local geology, following on the lines of Mr. E. J. Dunn, allocate the coal seams of the Transvaal to the Ecca beds of the Karroo formation. This allocation seems to be based upon a section of the coal measures to be seen at Vereeniging, where the coal seam occurs just above the Dwyka conglomerate, and is overlaid by another bed of conglomerate. It is somewhat difficult to follow this reasoning, because if the coal seam occurs between two conglomerate of Dwyka age, then the coal seam must be of Dwyka and not of Ecca age, as claimed.



Hlobane Colliery, Hlobane, Natal.

It is not uncommon to find beds of conglomerate occurring at different horizons above the glacial Dwyka conglomerate in the Transvaal coal fields, but I have never yet found, on close examination, that these beds of conglomerate were of glacial origin. (See letter, vol. vi., page 79, of the Transactions of the Geological Society of South Africa, 1903.)

It is never wise to generalise on a single section, as Dr. Corstorphine does in this case, and argue that because the coal seam at Vereeniging occurs just above the dwyka conglomerate it must be of either Dwyka or Ecca age. Had Dr. Corstorphine studied the productive coal measures of the Eastern Transvaal and Natal, he would have seen the productive coal measures thickening in an easterly direction, and in Natal, distinctly occupying a higher horizon than, and actually resting on, what are undoubtedly ecca beds. The writer has sunk several shafts at the Douglas Colliery below the horizon of the lowest coal seam to a depth of over a hundred feet, and passed through several beds of secondary conglomerates and what appeared to be puny representatives of the Ecca beds resting indirectly on the Dwyka conglomerate. In different parts of the

Eastern Transvaal similar traces of shales are to be found in positions giving strength to the view that possibily they may be of Ecca age, whilst at varying distances above these shales of probable Ecca age in settled beds of sandstone, the productive coal measures actually begin. Messrs. Dunn, Hatch, and Corstorphine are apparently mistaken in allocating the productive coal measures of the Transvaal to the Ecca age, for on neither stratigraphical, or any other convincing, grounds can any such allocation be justified.

On page 218 of the "Geology of South Africa," by Drs. Corstorphine and Hatch, occurs the following description of the Beaufort beds: "In the Beaufort series, as in the Ecca sandstones, mudstones and shales are the prevailing rocks with, however, a much greater prepondenance, so far as the Cape outcrops are concerned, of basic igneous rocks, which are almost exclusively doleritic. The sandstones differ from those of the ecca in showing no spheroidal weathering, and fall into two main types, the one coarse, hard, and resistent, occurring in thick beds and forming conspicuous escarpments on krantzes on the hillside or on the summits of typical flat-topped kopjes; the other soft and shaly, in thin beds weathering with the associated shales to gentle slopes. The sandstones have a clayey cement which is slightly calcareous. . . . . There is generally a good deal of carbonate of lime in the shales, and the lamimæ glisten with minute scales of mica. Both sandstones and shales show numerous ripple marks and in places sun cracks. Limestones occur as nodules or as thin beds among the sandstones and shales."

Now, had Drs. Hatch and Corstorphine been asked to describe the productive coal fields of the Eastern Transvaal and Western Natal, they could not have done better than by copying, with trifling exceptions, their apt description quoted above of the marked characters of the Beaufort beds in the Cape Province. As far as the Transvaal productive coal fields are concerned, there cannot be any hesitation in giving preference to placing them in the Beaufort series rather than in the Ecca.

The fact is that at Vereeniging the coal seam which occurs just above the Dwyka conglomerate is not repeated elsewhere, not even in the same neighbourhood, although it must be noticed that the distance between the lowest coal seam and the Dwyka varies considerably in different parts of the Transvaal. In the Springs district it is sometimes as much as fifty feet, thickening to one hundred feet in some cases in the Middelburg district, and as much as three hundred feet in the Ermelo district. It is clear, therefore, that the close proximity of the seam of coal at Vereeniging to the Dwyka upon which Drs. Hatch and Corstorphine build up their theory that the productive coal fields of the Transvaal are of Ecca age, is an exception rather than the rule, and far too flimsy a foundation upon which to seek to establish such an important conclusion.

North of Pretoria, at Hamman's Kraal, the writer sank several prospecting shafts in 1903 for coal, and although coal was found in one shaft, it could not be picked up at the same horizon in four other shafts in the immediate neighbourhood. Even where struck, the seam of coal varied in the shaft itself in thickness, and evidently was lenticular in mode of occurrence. The sandstones, too, were peculiar in appearance and presented some marked differences of appearance to those of the productive Transvaal coal fields. The shales were also much thicker and quite different from the shales in the productive coal measures, and carried quite a different assortment of fossils; in fact, the whole of the beds exposed were very puzzling. Since that date, the writer has inspected the Komati Poort coal field, and was much struck by similar conditions prevailing there, which the Government Geological Survey have since identified as probably contemporaneous with the Stormberg beds of Cape Colony.



Witbank Colliery, A Day's Output on Trucks

The geology of the Natal coal fields bears a striking similarity to those of the far Eastern Transvaal between Ermelo, Amsterdam, and Piet Retief, always, of course, excepting the Komati Poort coal field, which, as before remarked, possesses many characteristics quite distinct from those of the typical Transvaal coal fields.

The sandstones comprising the productive coal fields of Natal are of varied texture, running from fine to very coarse-grained, similar to those of the Transvaal, and constitute by far the largest proportion of the coal measures. Shales are less common, and may be described as remarkably fine grained sandstones rather than shales, but doleritic dykes and flows abound to a far greater extent than in the Eastern Transvaal, and frequently occur to such an extent as to have an important bearing on the economic value of the coal field.

The Karroo formation, in which the Natal coal measures occur, is more highly developed than anywhere in the Transvaal, and the divisions occurring in Natal attain a much greater thickness than do similar representatives in the Transvaal. In this respect the Karroo formation in Natal bears a much closer resemblance to

the same formation in the Cape. The Dwyka conglomerate is generally thicker than in the Transvaal, and, where exposed, is more striking, whilst the Ecca beds overlying the dwyka in East Natal attain to nearly the same thickness as in the Cape Province. The Ecca beds thicken east from three hundred feet near Vryheid to two thousand feet at Durban. Overlying the Ecca beds occur sandstones devoid of coal seams from five hundred feet to one thousand feet in thickness, then follow the productive coal measures, consisting of sandstones, shales, and dolerite, which, as before remarked in connection with the Transvaal, may be more properly regarded as being contemporaneous with the Beaufort beds of the Cape, rather than with the Ecca.

If stronger evidence is required than that offered by the Transvaal that the productive coal measures of Natal and the Transvaal belong to the Beaufort beds, it is to be found in Natal, where the sandstones, dolerites, shales, and coal seams comprising these measures are to be seen distinctly resting as described on ecca beds. Even as far west as Newcastle, in Natal, boreholes put down through productive coal measures enter the underlying Ecca beds.

In Natal, as in the Cape, many thousands of pounds have been spent in unsuccessfully prospecting for coal in the Ecca beds, which knowledge of local geology might in a good many instances have saved. Still there may be some excuse for the ordinary prospector being lured on to spend money in the face of the promising black shales to be found in the Ecca division. There cannot, however, be much excuse for a trained geologist to advise the spending of capital in prospecting for coal in the ecca beds in Natal, when they can be clearly seen to be below the productive coal measures.

The most glaring recent instance of wanton waste of capital in prospecting for coal in the Ecca beds was that on the Bluff at Durban, where about two thousand feet of boring was done without the slightest prospect of striking a workable coal seam. Further inland, similar mistakes have been made even after it was actually proved by boring in the productive coal field that the ecca beds were barren of workable seams of coal and occupied a lower horizon than that of the productive coal measures. No good purpose can, however, be served by pursuing the subject further. The only important light it is calculated to throw upon the geology of the South African coal fields is to confirm what has been stated regarding the geological age of the coal fields, and to confirm the opinion, already so freely expressed, that Drs. Corstorphine and Hatch, as well as Mr. E. J. Dunn, are in error in allocating the productive coal measures of the Transvaal and Natal to the Ecca beds when there is so much to be said in favour of their Beaufort age.

The Karroo formation also covers a considerable area of the Orange Free State, where it is represented by the Dwyka, Ecca, and Beaufort beds. In the northern part of the Province the Ecca beds appear to be either totally absent or but poorly developed, hence south of Vereeniging and Klerksdorp the Beaufort beds rest directly upon the dwyka conglomerate. It is in this portion of the Province that the workable coal seams occur. There are considerable areas, however, where the Beaufort beds do not carry a workable seam of coal, being thin and of inferior quality, far more so than is the case with the Transvaal. Both on the Natal side to the east and to the west, as well as to the south, the ecca beds are tolerably well developed, but, as before remarked, no seam of coal of any importance has yet been found to occur in these beds. The normal thickness of the Beaufort beds, say twelve miles south of Vereeniging, is over four hundred feet. Along the Vaal River near Vereeniging they are less than a hundred feet in thickness where they have probably been somewhat extensively denuded. South of Klerksdorp they run from about the same thickness and up to three hundred feet where denudation has not been so extensive.



Witbank Colliery, A General View

The productive coal measures of the Cape Province occur in the Stormberg series and in the lower division of that series known as the Molteno beds. These beds are composed of, alternately, sandstones and shales. The sandstones vary considerably in texture from that of a fine grain to a coarse grit, large bouldered conglomerates being also frequently found. The shales are generally found to contain plant remains and carry also coal seams, the latter being of irregular occurrence and of inferior quality, and contain a good many features allied to the scattered coal measures beginning at Hamman's Kraal, north of Pretoria. The peculiar feature about the coal seams in the Cape coal fields is the manner in which they occur in the shales, whilst in the Transvaal the coal seams not infrequently occur with a roof and floor entirely composed of sandstones, and even when the coal seam is accompanied by shale, it is is generally of insignificant thickness. As no coal of economic value occurs in the Beaufort beds in the Cape, it is not necessary here to enter into a detailed description, except to say that, as in Natal, dolerite flows and intrusions are common, whilst other characteristics are to be noticed in common with the productive coal measures of the Free State, Transvaal, and Natal.

In conclusion, it is necessary to point out that the question of the geological age of the coal-bearing beds in the Orange Free State, Transvaal, and Natal possesses more than a scientific interest. Were it proved, for instance, conclusively that these were of Ecca age, it would at once open up great possibilities of the discovery of enormous new coal fields in these parts of South Africa—especially Cape Colony and Natal, where the ecca beds are so well developed—a discovery which would be of enormous economic and commercial importance to these Provinces. It is nearly ten years since the writer pointed out that the productive coal measures of the Transvaal and Natal could scarcely be regarded as of Ecca age, and since that date all the additional information obtained has confirmed that view, a view largely strengthened and supported by the excellent work done by Dr. Mellor on behalf of the Government Geological Survey of the Transvaal.

Description of Coal Fields.

The Transvaal coal fields, for obvious reasons, have been explored and developed to a greater extent than those of the other Provinces, and especially those within profitable distance of the Rand. Several coal fields have, indeed, been already practically exhausted—that of Boksburg entirely—so whilst that known as the Brakpan-Springs area is rapidly approaching a similar condition, that known as the Witbank coal field, which at present supplies three-fourths of the coal output of the Province, has been taken up wherever within profitable reach of the railways, and is in a much further advanced state of exhaustion than generally known. Transvaal collieries, unlike Rand gold mines, have a habit of becoming prematurely and suddenly exhausted. There are, of course, exceptions, but the Brakpan Colliery was estimated at one time to have a life of a hundred years, and in fifteen years it was exhausted.

It is claimed that coal was first discovered in the Vaal River at Vereeniging by Stowe in 1879, where a small tongue of the Orange Free State coal field extends into the Transvaal, but a few years ago the underground workings at the Vereeniging Colliery took fire and got such a hold that as a producing unit it has ceased to exist and does not therefore call for any detailed notice. The principal coal field in the Transvaal, and the one to which resort must be had to meet the coal requirements of the Province, extends eastwards of the Wilge River from near Devon in the south to near the point at which this river joins the Olifant River. The productive coal area, however, extends but little to the north of the Pretoria-Delagoa Bay Railway, having been reduced considerably in area by denudation. To the east it extends to the town of Middelburg, and from thence passes south-east a few miles east of Carolina to a point near Amsterdam on the Swazi border. It then runs about halfway between Ermelo and Piet Retief, and continues about fifteen miles south of Bethal on to the Wilge River near Devon. Throughout this extensive area, some three thousand square miles in extent, the coal measures continue unbroken, but not so the coal seams. The principal coal seam has been denuded in places, but then other seams are exposed, and, practically speaking, this extensive area, although not wholly proved or prospected, may be regarded as one huge coal field. The seam worked at Witbank is the most persistent, but varies considerably in quality, and depreciates in both thickness and quality going west until at Ermelo it yields an average by analysis of twenty per cent. ash. An overlying seam sometimes becomes workable and of better quality, but the best is an underlying thin seam of uncertain thickness and not always present. The section of this coal field shows a gradual increase in thickness going east, and at Ermelo has a total thickness of five hundred feet, and still continues to thicken in the direction of Natal, until it gradually assumes similar features to the coal fields of that Province. Outside this huge coal field there are numerous scattered deposits of coal measures in different parts of the Transvaal, whilst productive coal fields may be hidden in the north and north-easterly portions of the Province, where little prospecting operations have taken place, the value of which are at present unknown. The Springs-Brakpan, for instance, is perhaps the best known and exploited on account of its close proximity to the Rand, where a thick coal seam, probably contemporaneous with the principal seam in the Witbank area, but of much inferior quality, has been exploited for many years, the best portions of which have already been exhausted. The Boksburg coal field, a similar small deposit, has been already exhausted. Near Heidelberg, again, several isolated coal deposits of varying value and extent are found, the most important of which is that known as the South Rand coal field, so extensively proved by Mr. Sawyer on behalf of the South Rand Exploration Company. Other deposits occur in the direction of Vereeniging, but mostly of little value, the most interesting perhaps is that at Syferfontein, near Zuurbekom, where a coal seam not properly tested occurs with a total thickness of over two hundred feet, but perhaps it would be more correct to describe this as a series of coal seams. A similar small coal basin of no value exists near Klerksdorp. There are also small deposits of coal measures to the east and north of Pretoria, but it is interesting to notice that, with the exception of the South Rand coal field, which really forms part of a large coal field extending into the Orange Free State, none of these isolated, scattered coal deposits contain coal of equal quality to that found in the Great Eastern coal field. To the north of Pretoria only a few miles quite a thick seam of coal occurs at the Rogerstone Colliery, but its quality is so inferior as to make it impossible to be worked at a profit. At Hamman's Kraal, still further north, another deposit of coal measures sets in. Several prospecting shafts were sunk in this deposit, which, judging from the strata, appears to be composed of beds quite distinct from the Ecca and Beaufort beds. The sandstones are false bedded, though promising in appearance, but they are evidently derived locally from the red granite, whilst the prepondenance of shales and accompanying fossils would apparently place them in a different horizon from that of the Beaufort beds. A coal seam was found in one of the prospecting shafts over two feet in thickness on one side of the shaft, but it thinned out to a foot on the other, and could never be picked up again in four shafts sunk in the immediate neighbourhood. Several similar coal measure deposits occur in the country on both sides of the railway between Pretoria and Pietersburg. Between Springs and the Wilge River occur several deposits containing inferior coal, mostly too inferior and irregular to work to a profit, the best, yet nevertheless inferior, deposit found being near Delmas, where coal of a semi-anthracitic character was discovered about twenty years ago. North of Bronkhorstspruit, inferior coal is also to be found. Similar deposits occur east of Middelburg, the best-defined and thickest seam being at Belfast, but work here has been abandoned for several years. A similar deposit occurs on the Lydenburg line of railway near Dullstroom, slightly better in quality than at Belfast, but still too inferior in quality to be worked at a profit or compete with the Middelburg coal.

The Komati Poort coal field presents some interesting features, and to the writer presents many features in common with the coal measures found near Hamman's Kraal to the north of Pretoria. The coal seams are of a similar uncertain mode of occurrence, somewhat lenticular, have the same easterly dip, and the same

quality save that they are metamorphosed into an inferior anchracite. They are, however, of doubtful value despite their excellent position as regards export, and their commercial value is not such as to justify a detailed description. By the Transvaal Geological Survey these are suggested as being contemporaneous with the Stormberg beds of the Cape.

The Orange Free State coal fields present a closer resemblance to those of the Transvaal than to those of Cape Colony; in fact, they may, south and east of Vereeniging, be almost regarded as the southerly extension of the Heidelberg coal field in the Transvaal. In the northern part of the Province, say at Vereeniging, the coal measures have been much denuded, and are only about one hundred feet thick. A few miles further south they are better developed, and at Coalbrook Colliery the coal measures, including the Dwyka conglomerates, are about five hundred feet thick.

The coal measures in the Orange Free State cover a considerable area, but they do not always carry workable seams of coal; in fact, there are considerable areas where the seam of coal is either too thin or too inferior in quality to work, or perhaps both. Generally speaking, the Orange Free State coal fields carry but one workable seam of coal. At the Coalbrook Colliery, about fifteen miles south of Vereeniging, the coal seam is over thirty feet thick, the lowest nine feet only being worked. The coal is superior to Springs, but not equal to that of Middelburg district of the Transvaal. The same seam, and of a similar quality, is worked near Viljoen's Drift. The coal is remarkable for its hardness and peculiar conchoidal fracture, which is likewise a peculiar feature of some of the Springs coal. This coalfield extends many miles south and east and west, but boring operations have in a good many instances shown the deposit to be barren of a payable coal seam; in several instances, however, inferior coal seams have been discovered and worked, but the thorough examination of this huge coal field is awaiting a profitable outlet, which can scarcely be said to exist at present. The best coal worked in the Orange Free State is on the coal field south of Klerksdorp about three miles, but continuous with that of Coalbrook and Vereeniging, around the Vredefort granite boss, and known as the Vierfontein coal field. On this coal field is situated the well-known Vierfontein Colliery belonging to the Kroonstad Coal and Estates Co., Ltd., put practically worked at present to supply De Beers with coal. The coal measures here run from one hundred feet to two hundred feet thick, and consist practically entirely of sandstone; even the coal seam has a sandstone roof and floor. The seam has a thickness of from six feet six inches to eight feet six inches, running practically horizontal, and very uniform wherever proved. The whole of this section is saleable, but, as is the case frequently in the Transvaal, the lowest four feet of coal is of better quality than the top four feet. This seam of coal has been proved by the Kroonstad Coal and Estates Co., Ltd., to extend fifteen miles continuously in a north-easterly direction, and is known to cover a much greater area. Practically the whole of the output of the Vierfontein Colliery, as stated above, approaching one hundred thousand tons a year, is taken by De Beers Company, who have a controlling interest in the colliery, and pay 6s. 9d. a ton at the mine. One peculiarity about the Free State coal field worthy of mention is its large proportion of sandstone and grits and the small area proved. So far, only one workable seam of coal seems to have been found, but, whilst varying in some instances considerably in value it probably covers an extensive area, and when conditions call for it will be able to supply a much larger output of coal than that of to-day.

Natal Coal Fields.

The Karroo formation is far better developed in Natal than in the Transvaal, both in the Beaufort and Ecca divisions, the largest and most important coal field extending in an irregular shape from Elandslaagte to Newcastle. This coal field approaches in size that of the Great Eastern Coal Field in the Transvaal, with which, in fact, it was probably continuous in coal measure times. It is, however, so much affected by dolerite flows, intrusions, and denudations that to-day possibly only about ten per cent. of its area contains marketable coal. South of the Biggarsberg the coal seams depreciate in quality and thickness and are separated by forty or fifty feet of strata.

The best portion of this coal field extends from Dundee to Dannhauser, where, generally speaking, the two workable seams are only separated by a few feet of strata. There are, however, even in this area, large areas of coal damaged and made unmarketable by huge dyke intrusions. It is from this small area that nearly all the good coal in Natal is worked. As a rule, mining operations have hitherto been principally confined to the lower seam, not because the upper seam is not saleable, but the method of mining in Natal is generally such that, owing to the little strata dividing the two seams, most of the upper seam is lost. Not only is this a wasteful method of working, but it has recently resulted in the upper seam taking fire spontaneously, causing several serious explosions, for, unfortunately,



Witbank Colliery.—The Main Shaft

in this district of Natal firedamp is often found. With an up-to-date method of mining, these underground fires and explosions can be probably avoided, as the strata accompanying the coal seams are favourable for the adoption of such a method of working as would not only prevent these underground fires and resulting explosions, but likewise enable the whole of the marketable coal to be extracted, and in not a few instances nearly double the output from what is the most important and valuable coal field in Natal.

These two coal seams extend as far north as Newcastle, where they outcrop just north of the town, but, as in the southern extremity of this coal field near Elandslaagte, they are separated by forty to fifty feet of intervening strata. The quality of the coal at Newcastle is good, but inferior to that near Dundee, whilst the higher railway rate to the coast militates against the opening up of this section of the coal field for bunkering and export purposes.

In other parts of Natal there are also detached coal fields, particularly at Vryheid, where some of the coal is only a little inferior to that worked near Dundee. There is also a coal field at Greytown, but the seams are thin and too anthracitic to be of any marketable value.

In Zululand, too, are extensive coal fields where the coal is even more anthracitic, but tests show the coal to be of comparatively little value.

Cape Coal Fields.

Owing to the inferior quality of the coal, the Cape coal fields are probably the least important of any of the coal fields in the Union of South Africa. The coal fields have in the past, when other coal was not available, served a useful purpose, but the extension of the railway system into other coal fields has enabled a supply of better coal to be obtained, with the result that the Cape coal mining industry has lately declined.

The coal seams vary considerably in thickness, and occur in shales in an irregular manner. The following are sections of a seam of coal exploited in the Cape Province for some time, which in other South African coal fields would have been regarded as unworkable: Roof shale, three inches; coal, nine inches; shale, nine inches; coal, five inches; shale, twelve inches; coal, ten inches; shale floor. Take another instance, that of the Fairview mine: Roof coal, three inches; shale, six inches; top coal, four inches; shale, two inches; coal, two inches; shale, six inches; bottom coal, ten inches.

The most important coal deposits in the Cape Province occur in the neighbourhood of Molteno, Cyphergat, and Indwe, where the shales carrying the coal seams outcrop in the Stormberg beds along the mountain sides. At Molteno one section of the seam is as follows: Top coal, nine inches; shale, five inches; and coal, one foot two inches. At Indwe the top coal varies from two feet to three feet, then comes a band of shale several inches in thickness, followed by the bottom coal three feet to four feet thick. It will be evident that this interbedding of shale with coal is a condition not at all conducive to uniformity of thickness or easy and cheap mining conditions. This same feature is also characteristic of those coal deposits north of Pretoria and Komati Poort, pronounced by the Transvaal Geological Survey to be probably of Stormberg age, so that in the Stormberg beds of the Cape Colony the prospects of finding a valuable coal field in the Stormberg division are not encouraging.

Output.

Coal mining in the Transvaal was only carried on on a very small scale before the discovery of the Rand, but since that date it has made steady and almost continuous progress; in fact, within two years of the discovery of the Rand, the output of coal exceeded that of any of the Provinces as now existing, and since that date has easily maintained that position.

Reliable figures of the output and selling prices do not seem to be available before 1899; however the following is supplied by the Government Mining Engineer:—

Year.	Output. Tons.	Value at Mine. £	Average Price per Ton at at Mine. s.	d.
1899	1,735,282	619,406	7	1
1900	506,074	197,127	7	9
1901	797,144	329,113	8	4
1902	1,590,333	637,640	8	0
1903	2,253,677	877,976	7	4
1904	2,409,033	883,891	7	4
1905	2,606,799	846,272	6	5
1906	2,892,404	832,315	5	9
1907	2,883,423	773,649	5	4
1908	3,012,692	794,949	5	3
1909	3,623,656	916,452	5	0
1910	3,974,376	987,260	4	11
1911	4,343,680	1,020,539	4	8

The output of coal in the Transvaal has always been in excess of the demand owing to the ease with which it can be worked and the plenteous supply hitherto available. The history of the output is revealed in the constant downward trend of the selling prices, which only average a third of what they were twenty years ago. Meanwhile the output has continued to steadily increase, and so long as the output of gold increases and railways are extended, this increased output seems destined to continue.

Coal was worked in Natal in the neighbourhood of Dundee on a small scale since 1870 or thereabouts, but it was not until nearly twenty years later that a real coal industry was started. Since 1889 the output of coal has continued, with few exceptions, to show a steady annual increase. Before the war period of 1899 the output was quadrupled in ten years, whilst during the ten years following peace a similar increase is noticeable. Owing to the distance from the Rand, the Natal Collieries have never been able to send coal to the Witwatersrand gold mines for steam purposes in direct competition with the collieries in the Transvaal, not even since the Transvaal duty on Natal coal was abolished; but it is remarkable that, despite this market not being available, the Natal output of coal has continued to steadily increase despite the many disadvantages against which it has had to fight. The following figures will show the steady growth of the Natal coal mining since its establishment as an industry:—

Year.	Output. Tons.	Value. £	Average Price per Ton. s.	d.
1889	25,609	12,805	10	0
1890	81,547	40,777	10	0
1891	87,774	43,887	10	0
1892	142,160	71,080	10	0
1893	129,925	64,963	10	0
1894	141,010	70,505	10	0
1895	160,115	80,058	10	0
1896	216,106	108,053	10	0
1897	243,960	121,980	10	0
1898	387,811	175,015	9	2
1899	328,693	139,800	8	6
1900	241,330	241,330	20	0
1901	569,200	549,439	19	3
1902	592,821	512,574	17	3
1903	713,548	418,975	11	8
1904	858,298	457,000	10	8
1905	1,129,407	467,162	8	3
1906	1,238,703	524,296	8	5
1907	1,530,043	690,311	9	0
1908	1,669,774	737,190	9	4
1909	1,786,583	633,604	6	11
1910	2,294,746	688,421	5	11
1911	2,679,551	725,448	5	5

The Natal collieries are at the present time largely dependent on the bunker sales of coal at Durban for

the disposal of their output, and it is in the cultivation of that trade that the coal industry has made most progress. It has long been expected that the railway rate to the port on export coal would be materially reduced, and thus enable the collieries to cultivate an export trade particularly with India and the East. When the last reduction of railway rates was arranged, it was hoped that an adequate reduction on export coal would be made to enable the Natal collieries to secure a material share of the orders for coal given out by the Indian Railways. Great was their disappointment when it was announced that only a rebate of a shilling per ton on export coal would be allowed, a rebate quite inadequate to enable the Natal collieries to extend their export trade as anticipated to the Indian markets. A rebate of at least two shillings per ton is necessary for this purpose, and last year's average selling price of five shillings and five pence per ton shows how impossible it is to reduce selling prices any further than the Natal collieries have already done in the hope of increasing their sales.

Orange Free State Output.

The coal worked in the Orange Free State is only of second-rate quality when compared with that of the best worked in Natal and the Transvaal, but it is nevertheless a useful coal and for some time was largely used on the Cape Government Railways, whilst a fair tonnage is still sent to Kimberley. The coal fields are, however, about twenty miles too far from the Rand to enable the collieries to compete with the best Transvaal coals, and this fact has all along militated against their rapid development. Perhaps when the existing collieries in the neighbourhood of Witbank are worked out (a condition likely to be reached much sooner than generally expected), this second-rate coal of the Orange Free State may find a much larger demand on the Rand.

The following figures show the output in the Orange Free State for the last five years, during which period it will be seen that little or no progress has been made.

Year.	Output. Tons.	Value. £	Average Price per Ton. s.	d.
1907-8	524,487	145,373	5	6
1908-9	470,590	125,627	5	4
1909	276,982	71,423	5	1
Last 6 months) 1910	469,762	131,728	5	7
1911	482,690	137,616	5	8

Cape Output of Coal.

The output of coal in the Cape Province, instead of showing a steady and almost uniform increase as in the Transvaal and Natal, has during the last dozen years shown a more or less steady decrease until it is less than one-half of its dimensions of a dozen years ago.

This is due to the inferior quality of the coal and its inability to compete with the coal from the other Provinces, as also to its high cost of working and the fact that the railway has at last seen the futility of nursing the Cape coal trade at the expense of the taxpayers. It is probable that in a few years' time the coal industry of the Cape will have practically ceased to exist, as nearly all the leading collieries are threatening to close down unless the railway contracts are continued, so that in the future only sufficient coal will be probably worked to partially meet local requirements.

The following figures will show at a glance the position of the Cape coal trade for the last twelve years :—

Year.	Output. Tons.	Average Price at Mine. s.	d.
1899	208,655	12	10
1900	198,451	13	4
1901	205,810	17	6
1902	185,424	17	1
1903	207,493	17	3
1904	172,785	17	9
1905	164,122	16	8
1906	142,877	16	6
1907	144,040	16	6
1908	122,865	14	11
1909	103,281	12	9
1910	98,057	12	2
1911	89,023	11	7

Quality of Coal.

In coming to the question of dealing with the qualities of South African coals, many difficulties present themselves in obtaining reliable information. The qualities of coal vary so much that the analyses, however correct they may be in themselves, can be made to show the output of a colliery much worse than it is or much better, the whole question of reliability resting on the manner of taking and the trustworthiness of the samples sent to the analyst.

Many of the published analyses of South African coals are known to be misleading, because the sampling has been done on such lines as are calculated to show the coal at its best, and not at its true commercial value. On this account little value can be attached to an analysis of coal unless at the same time the exact method of taking the sample is known.

The procedure of sampling the coal must be governed by the method in which the sample is to be obtained; that is, from the face of solid coal in the mine, from picking belts, bagged coal, or bulk coal, always, however, bearing in mind the object aimed at in taking the sample. If the object of taking a sample is to find out the class of output the mine can under normal conditions produce, the sampler must be thoroughly conversant with practical coal mining. If the sample is wanted for commercial purposes, the sampler must then understand the commercial aspect of the question, and if he understands mining so much the better. In no case, however, should the sampling be trusted wholly to a chemist or analyst unless he is known to be acquainted practically with both the mining and commercial aspects of the question, because without reliable sampling the results attained by the chemist will be of little practical value.

So important is the question of sampling in the matter of obtaining reliable information about coal, that the South African Engineering Standards Committee, supported by all the scientific and technical societies in the Transvaal, have given considerable attention to the subject and issued a special report giving suggestions as to the best methods to be adopted to obtain reliable samples for analysis.

The sub-committee on coal comprises Professor J. A. Wilkinson, Dr. Moir, and Messrs. Robert Allen, J. Q. Braidwood, Andrew F. Crosse, James Gray, A. McArthur Johnston, and Arthur Whitby, names that ought to guarantee the matter being dealt with in a proper manner.

The report already issued divides the subject under the following heads: Colliery sampling, bunker sampling, and sampling of trucks when loading, in transit, unloading, and also bag sampling. This committee has also issued a report on standard methods of analysis, and the question of the standardisation of the various sizes of coal for commercial use is at the present time being dealt with by the committee. To those interested in this question these reports will be of special value.

As in Australia and India, the coal in South Africa varies considerably and is not at all consistent over considerable areas, as in most coal fields in the northern hemisphere. In nearly every Province in South Africa the coal not only varies in quality in every district, but also to some extent in every individual colliery. Nevertheless, when observations are made in a reliable manner over extended areas, remarkably uniform results are often obtained.

It will come as a surprise, however, to many to hear that the best coal yet discovered in South Africa is in the Cape Colony, and yields the following results by analysis: Fixed carbon, 87.19 per cent.; volatile matter, 11.59 per cent.; moisture, 1.02 per cent.; and ash, 0.20 per cent. Its evaporative value is 16.318. It occurs in the Ecca beds in Cape Colony, and its origin has not yet been satisfactorily explained. It is only found, however, in thin, irregular deposits, costly to mine, and, as it is of no practical value, may be dismissed without further notice, being generally regarded as a freak of nature.

The best steam coal yet discovered in extensive deposits in the Union of South Africa and workable on a large commercial scale is admitted to be in Natal. It has some common features with Welsh coal, having been metamorphosed from a highly bituminous to a semi-bituminous coal in a similar manner. It is, however, much higher in ash and lower in fixed carbon than Welsh, that is where there is ample volatile matter present to reach the required standard of a steam coal. The best steam coal in Natal probably comes from the neighbourhood of Hatting Spruit and Vryheid, and is produced at the Natal Navigation, St. George's, Glencoe, and other neighbouring collieries. For special purposes the Natal Navigation coal has in the past been in greatest favour and mostly used on the railway on important occasions. Some excellent coal has also been produced at the Dundee colliery, but that colliery is now worked out and exhausted. Good coal is also produced near Vryheid, a newly-opened concern, the Hlobane colliery, having recently become one of the leading coal producers in Natal. Its rise to that position, due to a large extent to liberal support from the railway, is one of the most recent striking features of the Natal coal trade.

Next after Natal coal comes Wankie coal in Rhodesia, which, although outside the Union of South Africa, may well be mentioned here. Three reliable analyses have been published by Mr. James Gray, F.I.C., consulting analytical chemist, of Johannesburg, the samples being taken personally by himself from a truck of coal despatched in the ordinary business routine to Salisbury The samples taken were divided into three classes: (1) round coal, (2) nut coal, (3) dull coal, the analyses being as under:—

	1	2	3
Moisture	·71	·23	·57
Ash	10·11	12·46	15·31
Volatile Matter	22·96	25·32	22 02
Fixed Carbon	66·22	61·99	62 10
	100·00	100·00	100·00
Evap. Power by Mahler's Bomb	13·78	13·64	13·00

Mr. John Hynd has also publishted five analyses of samples of coal taken over the whole width of five different working faces at the Wankie colliery as under:

	1	2	3	4	5
Fixed Carbon ...	65·13	64·50	62·72	63·80	64·85
Volatile Matter ...	22·67	20·71	19·41	21·90	23·36
Ash	9.96	11·29	12·96	11·33	9·70
Sulphur	1·54	2·62	4·18	2·36	1·42
Moisture	0·70	0·83	0·73	0·61	0·67
	100·00	100·00	100·00	100 00	100·00

Evaporative Power by Mahler's Bomb varies from 13·69 to 14·08.

It may be said that the best Wankie coal appears to run close to Natal coals, whilst the worst Wankie coal occupies a similar position to the best coal from the Witbank coal field of the Middelburg district of the Transvaal.

With regard to Transvaal coals, the best coal worked on a large commercial scale is that from the Witbank coal field in the Middelburg district, where, as before remarked, it follows closely on the heels of the dull coal produced at the Wankie in Rhodesia. There are, however, small areas of better coal than Middelburg to be found in the Eastern Transvaal, one seam giving the following average analysis over a width of six feet: Fixed carbon, 68.12 per cent.; volatile matter, 18.89 per cent.; ash, 11.15 per cent.; and moisture, 1.84 per cent. This coal in appearance and quality can scarcely be distinguished from Natal coal, being semi-bituminous and, like Natal coal, appears to have been metamorphosed from a highly bituminous coal. However, taking Witbank coal as a standard, the Transvaal possesses many other inferior coals and but few above that standard of quality.

The best of the Orange Free State coals fail to come up to the Witbank standard, but there are, nevertheless, several good, useful coals in the Orange Free State, and somewhat superior to the common or third-grade coals worked in the Transvaal.

The worst coals yet attempted to be worked on a large scale in South Africa are those in the Stormberg district of the Cape Province. They are very high in ash, too anthracitic, and can easily be placed at the foot of the scale of qualities for the whole of South Africa.

Taking the Provinces of the Union in their order of importance as productive units, the Transvaal comes easily first, and of the Transvaal coal fields the Middelburg coal field takes first place, not only as regards output, but also for the general quality of its output.

The best coal is produced in the immediate neighbourhood of Witbank, and within a radius of ten miles of Witbank Station, all the coals at present being worked outside this limited area either carry too high a portion of volatile matter or ash to excel in quality the coals worked in the Witbank coal field proper.

The individual colliery producing the best coal in this area is difficult to fix upon, because the quality of the coal produced varies at each colliery when taken over a period, and the coal at these half a dozen collieries is so remarkably close in steaming capacity that the honour may easily be divided at different times with more than one colliery. A dozen years ago the Transvaal and Delagoa Bay Collieries were recognised as producing the best coal, afterwards Coronation, but since the Landau Colliery opened the bottom seam an equally good coal has been produced there. Tavistock coal also later became a favourite, and since the Witbank Company opened the Outspan Colliery, the quality of their output has improved, until the question becomes a difficult one to decide. Over many hundred analyses taken at different times, the average analysis of the several collieries in the Witbank district comes out as follows:—

Colliery.	Specific Gravity.	Moisture.	Ash.	Volatile Matters.	Fixed Carbon.
Cassel Landau	1·4	1·62	13·39	28·52	56·47
Coronation	1·4	1·63	13 27	27·53	57·57
Middelburg Steam	1·4	1·45	14·50	24·50	59·55
Tavistock	1·4	·80	11·99	25·27	61·94
Transvaal & Delagoa Bay	1·4	1·30	15·72	24·16	58·82
Witbank	1·4	1·37	12 90	24·31	61·42
Outspan Colliery	1·4	1·50	11·44	27 00	60·06

The theoretical calorific value by Mahler bomb of the coal produced at these collieries runs from 12.30 to 12.90 lbs. of water evaporation per lb. of coal.

These figures show how remarkably uniform the quality of the coal is over the limited section of the

Middelburg coal field on which these collieries are operating, and how impossible it is to make any marked distinction in the quality of the coal from any individual colliery.

Further to the west are collieries producing coal of a very useful quality, but scarcely equal to the Witbank standard, such as, for instance, the Crown, Douglas, and Premier Collieries. The coals here are slightly higher in ash and moisture contents and lower in volatile matters, but not to any great extent. The following represent the average of a large number of analyses taken of these coals :—

	Specific Gravity.	Moisture.	Ash.	Volatile Matters.	Fixed Carbon.	Calorific Value.
Crown Colliery	1·45	3·06	16·13	20 00	60·81	11·81
Douglas Colliery	1·45	2 55	14 35	24·09	58·01	12·39
Premier Colliery	1·45	2·14	15 04	23 04	59 78	12·50

The seam of coal worked at these collieries is probably the same seam as that worked at Witbank, but being comparatively shallow and situated in an area where there has been considerable denudation, may perhaps account for the slightly lower quality. Further to the south, as far as Devon, and west, also, at Bronkhorstspruit, there are patches of coal measures carrying coal of much inferior quality to those mentioned above.

Lying to the south-west of Witbank and extending to the Wilge River is another productive coal field in the Middelburg district, on which are situated such important concerns as the Anglo-French, Tweefontein, and Oogies Collieries. All these collieries are working the same seam of coal as is so largely worked in the Witbank coal field, the only difference being, perhaps, that the coal is a trifle more volatile and scarcely comes up to the true Witbank coal in calorific value, but the difference is not such as to call for detailed notice. The following are average analyses for these coals as placed on the market to-day :—

	Specific Gravity.	Moisture.	Ash.	Volatile Matters.	Fixed Carbon.	Calonfic Value.
Anglo-French	1·42	2·08	15·32	26 83	55·77	12·26
Tweefontein	1·43	2·23	15·44	25·26	57·07	12·31
Oogies	1·43	1·86	15·38	27·58	55 18	12·32

It will be noticed that these analyses run remarkably close although the mines are widely separated, but there are, nevertheless, large areas of coal-bearing country in this coal field intervening and otherwise where the coal is of a more inferior quality. Further to the south again there are several limited areas of good coal, followed still further to the south by coal of an indifferent quality.

The continuation of the Witbank coalfield due east in the direction of the town of Middelburg is interrupted by older rocks outcropping at the surface, but only for a limited distance near the Olifants River, when the coal measures again make their appearance. On this coal field occurs the African Freehold and Vaalbank Collieries, the coal hereabouts being dull in appearance, but, on the whole, better than it looks. The quality varies, however, considerably, and as this coal field has only produced a limited output as yet, reliable information on the value of this field, on the whole, has not become as yet available. Picked samples of coal have, however, yielded good results, but they can scarcely be taken to represent the true value of the coal field. Volcanic lava flows are to be found in the neighbourhood, and they seem to have affected the quality of the coal in several places. The ash in some cases runs as high as twenty-five per cent. and the volatile matters as low as fifteen per cent. The influence of these volcanic lava flows seems to extend still further to the east, and at Eikeboom, where the Witbank coal measures become more normally developed, the coal is high in fixed carbon but somewhat low in ash and volatile matters. It is, however, quite up to the Witbank standard, although insufficient mining has scarcely been done in this area of the Middelburg coal field to establish the area of coal likely to come up to the present Witbank standard.

Further to the north and east of Middelburg, along the Pretoria-Delagoa Bay line of railway, inferior deposits of coal have been found and worked to a limited extent. The most important was at Belfast, but, owing to its inferior quality, the colliery has been for some time closed and dismantled. An attempt is being made to work a similar deposit at Zwaartkoppies, but the coal as put on the market has proved so inferior as to be quite impossible for the railway to use and keep steam with it. Still, the decision to build the Lydenburg line from Belfast was, nevertheless, largely influenced by the existence of this inferior deposit of coal, as likewise the fact that the shares were held by influential people. The ash is higher than Witbank, but whilst it makes a fairly good house coal, as a steam coal it is decidedly inferior, its theoretical calorific value being only in the neighbourhood of nine, as compared with over twelve for the second-grade coal produced in the Witbank coal field. Lying due south of Belfast and Wonderfontein there is an extensive area occupied by similar inferior coal stretching nearly all the way to Carolina, but the coal seams are somewhat reduced in thickness. Probably the seam of coal worked at Belfast for some time, as also that at Zwaartkoppies, is contemporaneous with the main Witbank seam in geological age, but until the better descriptions of coal to be found in the Great Eastern Coal Field are exhausted, there does not appear much prospect of these inferior coal deposits being worked on an extensive scale, much less for export purposes.

Due south of the town of Middelburg, commencing at Eikeboom, there would appear to be another area of good coal, but untapped by a railway, of which the following may be regarded as an average over a large number of analyses: Moisture, 2.80 per cent.; ash, 9.90 per cent.; volatile matter, 22.15 per cent.; and fixed carbon, 65.15 per cent. Calorific value, 13.06. Samples of coal may be selected from this area carrying a remarkably small percentage of ash, and indications point to this field as the one most likely to supply coal equal, if not superior, to the present Witbank standard when the Witbank area has become worked out. It is possible that this area of good coal extends nearly all the way to the old Steenkoolspruit coal field twelve miles west of Bethal, and where small scale coal mining was carried on in the old days principally to supply the Rand gold mines with smithy coal.

The country lying to the south of the Brakpan-Witbank line of railway east of the Wilge River has been proved to carry the main Witbank seam of coal throughout its area as far south as the Springs-Eastward line of railway, but in the southern fringe of this coal field and all along the Springs-Eastward line, commencing near Devon, the coal seam is inferior in quality to the present Witbank standard wherever it has been proved. For the greater part of this area the theoretical value of the main coal runs between ten and twelve. There is, however, a thin seam of coal sometimes found immediately underlying the main seam which in places gives a higher theoretical calorific value than the main seam at Witbank, but its occurence and thickness are somewhat uncertain. Another seam of coal forty to fifty feet above the horizon of the Witbank main seam throughout the whole of the Great Eastern Coal Field is sometimes found in a sufficiently good condition to work, but whilst constant in its

occurrence, its quality varies considerably. This position of affairs apparently continues east along the railway line, through Bethal to Breyten, and nearly to the Swazi border, but it must be noted that, generally speaking, the coal seams decrease in thickness going east, as well as in quality.

In the Breyten district, where a large colliery has been recently opened, the thickest seam exposed on Smutsoog, close to Breyten Station, was analysed by the African Banking Corporation in 1905, the two samples submitted showing the following results :—

	S.G.	Moisture.	Volatile Matters.	Fixed Carbon.	Ash.	Calorific Value.
No. 1	1·60	3·30	17·30	58 20	21·20	10 34
No. 2	1·42	2·60	27·30	58 80	11·30	12·48

The No. 1 sample represented the top seven feet of the seam and No. 2 sample the lowest foot, so that in working this seam of coal to best advantage coal of an average theoretical calorific value of about 10.75 only would be produced, which seems to be about the average of the main Witbank seam all the way from Devon to Breyten. The thinner seams at Breyten Colliery have a theoretical value of about twelve. This main seam of coal, where found and worked at Ermelo, is even worse in quality and steam-raising capacity, where it has thinned down to six feet in thickness and the percentage of ash increased to nearly twenty-five per cent. It should, however, be pointed out that, being highly volatile, as a rule the coal burns readily, leaving a soft, pulverent, non-clinkering ash, and, generally speaking, is a favourite fuel with the stokers, which fact goes a long way in compensating for its disadvantages. In the neighbourhood of Ermelo the seam of coal overlying the main Witbank seam often increases locally to a thickness of from three feet to five feet, and where so developed is superior in quality to the lower or principal seam of coal. There are even instances where it is superior to the best of the Witbank coals, the ash contents falling to as low as six per cent. and the fixed carbon reaching as high as seventy per cent. This thickness of coal does not, however, cover extensive areas, the seam for the most part being too thin to work, often being about two feet thick only. East and south of Ermelo the coal seams improve somewhat in quality, are more consistent, but never very thick, and as a rule the average theoretical value of the coal will not exceed twelve, but owing to its high volatile contents and clean characteristics, it is a good and serviceable coal and generally popular for steam-raising purposes.

In the Carolina district the coal varies considerably in quality, the main thick seam being as a rule somewhat high in ash, but the lower seam, which runs from three feet to four feet six inches in thickness, although decidedly cleaner owing to its high volatile contents, rarely exceeds a theoretical calorific value of twelve. Before these far eastern sections of this Great Eastern Coal Field were intersected by railways, a general impression prevailed that the coal was infinitely superior in quality to that so extensively worked at Witbank, but this is only true of very limited areas, and, taken on the whole, the best of the coal is a little lower than the present guaranteed quality of Witbank coal. In some instances, however, where the volatile contents of the coal have been reduced, the quality has been improved and compares favourably with Witbank coal. Speaking generally, however, the ordinary coals, where low in ash, are somewhat too volatile for steam purposes, and are, moreover, much thinner than the main Witbank seam of coal extending throughout the district.

Much has been heard about the Komati Poort coal field, but from the limited amount of work done thereon it is clear that its value has been somewhat over-rated. Where the information contained is reliable, it shows that the coal seams are semi-bituminous and vary considerably in thickness and quality wherever sunk to. The percentage of ash is so high, generally over twenty per cent., and volatile contents so low, that the coal may be considered as of no marketable value at present. This coal field extends into Swaziland, and going south the ash contents decline, but the coal carries too little volatile matter, it is to be feared, to be regarded as a serviceable steam coal. Where the ash is comparatively low and the coal does not clinker, it might perhaps be used for gas engines, but the consumption for this purpose in South Africa is still so small that it is totally inadequate to keep even a small colliery fully at work.



Oogies Colliery

In the north-eastern corner of the Transvaal, close to the Portuguese Territory, in what is known as the Motali district, a similar coal-measure area, probably of Stormberg age, also occurs. The only coal seam proved in a deposit two hundred and seventy feet thick is eight feet thick, but it is much split up by bands of shale, and appears to be of comparatively little value.

A more promising discovery has, however, been made in the Northern Transvaal on the farm Rotterdam No. 1451, about sixteen miles south-west of the Messina copper mine, but it is only a small patch, probably not exceeding two square miles in extent. The coal seam varies from eighteen inches to four feet in thickness, and dips in a westerly direction. A shaft has been sunk proving the coal measures to be one hundred and fifty feet in thickness, a coal seam three feet thick occurring at a depth of thirty-six feet in the shaft. An analysis by Mr. Moseley gives the following results : Moisture, .95 per cent.; ash, 17.34 per cent.; volatile matters, 32.96 per cent.; fixed carbon, 48.75 per cent. The specific gravity is stated to be only 1.343, whilst the theoretical calorific value is given as 13.14. Judging from the analysis quoted above, the coal in actual use can scarcely be expected to yield such excellent results as the theoretical value would imply, nevertheless, at the Messina copper mine, where it is being used for

steam purposes, it is found to give fairly satisfactory results. This coal deposit appears to be of Beaufort age, like the majority of the other Transvaal coal fields possessing economic value.

The Great Eastern Coal Field, extending from Devon to the east of Carolina and from the town of Middelburg, say, to a point about thirty miles south, midway between Ermelo and Bethal, is, of course, the largest and most important coal field in the Transvaal, but west and south of this huge field isolated coal fields occur all the way to Boksburg on the one hand, to the Vaal River south of Heidelberg on the other.

Little need here be said about these small coal fields west of the Wilge River, where the coal varies so vastly in quality, but is rarely found sufficiently good to compete on even terms with the Middelburg coal, although in the past the Boksburg, Brakpan, and Springs coal fields have been of inestimable value to the Witwatersrand gold fields. Moreover, several of these coal fields are practically exhausted, although attempts at mining will probably be carried on for many years on some of these coal fields deposited in the hollows of the dolomite formation between Springs and the Wilge River. Near Delmas two small collieries are being opened in coal deposits where the coal, although inferior in quality, is highly anthracitic in places, suitable for use in suction gas plants, but comparatively useless for steam purposes. Some of these patches, however, carry limited quantities of coal sufficiently volatile for steam and stove purposes, whilst their comparative freedom from smoke and soot is much in their favour, but their importance do not justify detailed description here.

Other isolated deposits of inferior coal occur in the Heidelberg district, but none are being worked to such an extent as to merit attention. By far the most extensive deposits of coal measures in the Heidelberg district occur to the south of the railway line from Germiston to Volksrust, the most important of these being that known as the South Rand coal field south of Balfour Station, where an up-to-date colliery has for some time been established. The coal at this colliery has been proved to extend over a very large area, and is semi bituminous, but in quality approaches for steam purposes the second-grade coal of the Middelburg district. It is much liked on account of its comparative freedom from soot and smoke, and when some time ago it was temporarily closed down on account of an underground fire, some regret was expressed by many of the consumers. The following is an average analysis of the coal from the colliery belonging to the South Rand Exploration Company, Ltd.: Moisture, 3.78 per cent.; ash, 13.73 per cent.; volatile matter, 20.61 per cent.; and fixed carbon, 61.88 per cent., the theoretical calorific value of the coal being 11.30 Mahler's bomb. The specific gravity of the coal is practically the same as Middelburg, namely, 1.4.

The next coal field of importance is that at Vereeniging, being an extension of the Free State coal field into the Transvaal. The Vereeniging is supposed to be the pioneer colliery in the Transvaal, but owing to an outbreak of fire underground production ceased some time ago. The coal is of inferior quality, carrying a somewhat high percentage of ash as compared with Middelburg coals, its theoretical calorific value being in the neighbourhood of ten, and it must, therefore, be included in the third-grade coals of the Transvaal. The following is an average analysis of a picked sample of Vereeniging coal: Moisture, 5.05 per cent.; ash, 16.42 per cent.; volatile matter, 26.00 per cent.; fixed carbon, 52.53 per cent. Calorific value, 10.42.

Midway between Vereeniging and Krugersdorp occur other isolated coal deposits; one at Syferfontein carrying a coal seam with intervening shale bands over two hundred feet thick. The coal is of third-grade quality, however, and has not been worked during the past ten years.

The most striking feature of this Syferfontein coal was not its high percentage of ash, but its high percentage of volatile matter and moisture, a dried average sample giving the following analysis: Ash, 14.5 per cent.; volatile matter, 46.4 per cent.; and fixed carbon, 39.1 per cent. In practical use at the gold mines the evaporative efficiency of this coal was very low.

A very interesting report was made for the Coal-owners' Association in 1910 on the suitability of the best Middelburg coals for export purposes, in which, naturally, the question of quality bulks somewhat largely. The results of these investigations were given as under:—

Name of Colliery.	Moisture.	Ash.	Volatile Matters.	Fixed Carbon.	Calorific Value by Mahler Bomb.
Cassel Landau	1·46	10·82	30·11	57·61	13·53
Coronation ...	1·73	11·21	29·37	57·69	13·51
Outspan ...	1·62	10·32	26·97	61·09	13·47
T. & D.B. ...	1·32	12·77	28·90	57·01	13·19
Middelburg St.	1·38	12·76	26·95	58·91	13·06
Witbank ...	1·65	12·92	28·73	56·70	13·06
Tavistock ...	1·86	12·92	24·72	61·30	13·02
Anglo-French ..	2·16	14·03	30·00	53·81	12·55

To those possessing practical knowledge of Witbank coal, the percentages of ash mostly given above are less than the average under normal conditions of working, whilst the theoretical calorific value of the coal, averaging as it does over all the collieries 13.17, appears also somewhat too high. Taken over an extended period, the actual theoretical value of the coal produced at these collieries is really 12.80, the guarantee to the mines given by the Transvaal Coal-owners' Association being 12.50. No doubt with very close sampling the above results might be obtained, but they are not such as would pay the collieries in the Witbank district to attempt to obtain under normal conditions of large scale mining.

This is only another instance as showing how absolutely necessary it is that those engaged in coal sampling for a special purpose should be possessed of the necessary mining and technical knowledge and training to enable the samples obtained to be in strict conformity with the objects aimed at so as to ensure absolutely reliable results, otherwise they must be disappointing and misleading and of little practical value to consumers.

This raises the question of the present-day aspects of the commercial side of the quality of the coal question. Now that most of the large consumers of coal in the Transvaal fix the price they have to pay according to a standard theoretical calorific value, and regulate the price according to that standard, selective mining becomes as necessary at a colliery as at a gold mine, whilst at the same time it becomes equally necessary to keep it within sane limits. Underground conditions, more particularly as regards the thickness of the different grades of coal vary in different collieries, and if collieries are grouped to supply a certain market the standard of guaranteed calorific value must be placed at such a level as will allow that group of collieries as a whole to come up to that standard with ease without needing any modification in the normal methods of mining and sorting. To guarantee a calorific value of 13.17, or lead the consumers to expect such a value when the collieries under the best normal working conditions only supply coal of an average value of 12.87, may not seem a great difference in itself, but it is not either a good business or mining policy to attempt it, as it would be calculated to result in a lower pit-top selling price on the one hand and a higher cost of working per ton on the other.

Where, as in the Transvaal, thick seams with varying grades of coal occur, it requires some practical mining knowledge to fix the best standard of quality for the collieries. It ought to be the object to work as much of the seam as possible and send as little as possible of the output to the waste heap. If, for instance, abnormal efforts are made to increase the theoretical value from 12.50 to 13.17, it only means adding three pence to the selling price, whilst every additional ton of coal rejected and sent to the waste heap represents a dead loss of four shillings and sixpence per ton. This is an aspect of handling the output of a colliery which seems often to be either lost sight of or not fully realised, and whereas to-day in the Transvaal coal is sold so largely by units of value, it is highly desirable that at every large colliery some facilities should be provided to enable the manager to keep the coal as close to the guarantee as conforms most to the best interests of the colliery.

One of the large mining groups on the Rand gives the following results of the average calorific value of various coals supplied during the six months ended June 30th, 1912:—

MIDDELBURG DISTRICT.

Colliery.	Description of Coal.	Theoretical Average Value.
Cassel-Landau	Round Coal.	12·04
Coronation	Do.	12·74
Oogies	Do.	12·46
Witbank	Do.	12·38
Anglo-French	Do.	12·33

SPRINGS-BRAKPAN.

Colliery.	Description of Coal.	Theoretical Average Value.
Vischkuil	Round Coal.	9·60
Apex	Do.	9·46
De Reitfontein	Do.	9·58

HEIDELBERG DISTRICT.

Colliery.	Description of Coal.	Theoretical Average Value.
South Rand Exploration	Round Coal.	11·39

ORANGE FREE STATE.

Colliery.	Description of Coal.	Theoretical Average Value.
Cornelia Colliery	Round Coal.	10·46
Cornelia Colliery	Nut.	10·33
Clydesdale	Round Coal.	10·15

The above figures show a theoretical calorific average value of 12.70 lbs. for the Witbank district proper, 12.40 lbs. for the Anglo-French-Oogies, 9.48 lbs. for the Springs, and 10.30 lbs. for the Orange Free State coal fields. These figures may be taken as reliable, as they extend under normal conditions of working over a period of six months.

It is much to be regretted that no reliable independent working tests of Transvaal coals have been made similar, for instance, to those carried out in Natal and the Cape. Certain tests have been made by the South African Railways on different occasions in connection with placing the contracts for locomotive coal, but whilst those collieries whose coal give the best results in these tests are quite willing that they should be published, others, whose results were indifferent, are averse to their publication, and unless the whole of the collieries whose coal has been tested are willing to have the results published, there is nothing to be gained by publishing a few of the best only. Theoretical values are interesting as far as they go, providing the samples are properly obtained, but working tests under identical conditions would be of far more value for comparative purposes and indicate more truly the commercial values of the coals. To-day the large consumers of coal find it necessary to use different kinds of coal under different boilers, as naturally all coals do not give the same comparative results under the same boilers. In other words, theoretical values cannot be relied upon to the same extent as practical tests, and coals giving a comparatively inferior theoretical test under some boilers will give better results than coals of apparently a higher theoretical value; for instance, coals of a somewhat high volatile nature often show a relative higher theoretical value than in practical use they are capable of yielding, whilst coals with a low volatile percentage under ordinary boilers are useless. In arriving at the real values of coal for individual cases, practical tests are, therefore, necessary, and too much reliance should not be placed on theoretical values obtained by analysis.

In the Transvaal the coals, as a rule, do not suffer from carrying a too low proportion of volatile matters, although semi-bituminous coals occur at Komati Poort on a somewhat extensive scale, and small patches are found near Ermelo and in some of the isolated coal fields between Springs and the Middelburg coal field, apparently deposited in the hollows of the dolomite formation. All these coals carry a large percentage of ash, are unfit, therefore, for steam or any other purpose save suction gas, and may be dismissed from notice as being of little value. Despite the high ash and low volatile contents of these coals, unsuccessful attempts have been made use of them for steam purposes; some have even gone further, and sent trial lots to Durban and Cape Town as a smokeless steam coal. They undoubtedly make little smoke, but the drawback is that at the same time they make little steam. Transvaal coals of best quality suffer more from a superabundant supply of volatile matters, and the steaming qualities of the coals in a large proportion of the area of the Great Eastern Coal Field, including Breyten, Ermelo, and Carolina, suffer somewhat severely from this fact, although carrying a non-clinkering ash makes them popular with stokers despite their somewhat lower steam-raising efficiency.

At the Robinson Mine, the South Rand coal was carefully tested some years ago and evaporated 6.5 lbs. of water into steam, a result showing that the best was got out of the coal, but this test was useless for purposes of comparison with other coals.



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NATAL

It has already been pointed out that the best extensive steam-coal deposits found in South Africa are in Natal. It must not be concluded, however, that all the coal known to exist in Natal is excellent in quality, or even of commercial value. There are large areas in Natal so damaged by dykes and lava flows as to be of comparatively little value for present-day use, being a reverse condition of the affairs prevailing in the Transvaal, where the steam-generating efficiency of the best-known coals suffer through being too volatile. It is generally considered in Natal that unless a coal contains at least fifteen per cent. of volatile matter it is useless as a steam coal; that is, of course, providing it carries a normal percentage of ash. Twenty-one per cent. would perhaps be better, but in the Transvaal several of the best coals carry nearly thirty per cent. It is to be feared that much of the deeper-seated coal known to exist in Natal may prove to be anthracitic in character and damaged by dykes and igneous flows. Still it is probable that the excellent quality of Natal coal to-day is largely due to the influence of these igneous lava flows in driving off part of the volatile matter the Natal coal probably originally contained.

I have already spoken of the want of reliance that can be placed on a published analysis of coal unless something is known of the sampling methods adopted on such occasions. These remarks are equally true of Natal coals, whose general characters and contents are more likely perhaps to vary within short distances than are the coals of the Transvaal. However, as analyses, nevertheless, are more or less interesting, I append a few of the leading Natal coals obtained from the Government Blue Book published in connection with the coal tests made some years ago.

Analyses of Natal Coals made by the Government Analyst of Natal.

Colliery.	Specific Gravity.	Moisture.	Ash.	Volatile Matters.	Fixed Carbon.	Theoreti'l Calorific Value.
Natal Navigation	1·342	1·16	10·08	19 90	67·82	13·79
Glencoe	1·389	1·15	12 82	18·75	66·69	13 42
Durban Navigation	1·363	1·50	11·02	29·06	57·63	13 24
Elandslaagte	1·367	·95	15·20	22·06	60·00	12·73
Newcastle	1.388	2·60	11·52	28·96	56·10	12·24

When the above analyses were made, the Hlobane Colliery, now an important producer, had not been developed and worked, but the following analysis has been supplied: Fixed carbon, 63.05 per cent.; volatile matters, 25.34 per cent.; ash, 10.49 per cent.; moisture, .80 per cent.; and sulphur, .54 per cent. as indicating the value of Hlobane coal. When mined and supplied on an extensive scale, the Vryheid coal ranks close in quality to the best produced in the Hatting Spruit district. Elandslaagte and the Newcastle coals scarcely come up to the best standard coals of Natal, but are nevertheless good useful coals, and perhaps a shade better in quality than the best Middelburg coal at present produced in the Witbank district of the Transvaal.

In 1904, a special committee was appointed by the Natal Government to make exhaustive and reliable tests of the comparative value of Natal coals, and the results were published in a blue-book which at the time attracted some attention. They are far too lengthy to be produced in detail here, but the evaporative efficiency, speed of steaming, and percentage of residues as obtained with a Reid boiler are quoted below. These tests, made under Government auspices, may be considered to be free from any desire to show any coal to be superior to any other. The method of obtaining the coal for the purpose of the tests was also such as to ensure that the coal represented the normal produce of the collieries. No special mining or sampling was undertaken for the purpose of the tests, the coal being attached unknown to the collieries when in transit to the customers. Where collieries had not railway connection, the mining of the coal was conducted under independent supervision, with the object of showing the real value of the ordinary output of the colliery.

Evaporative Efficiency of Natal Coals.

Natural Draught.		Light Draught.		Medium Draught		Full Draught.	
Nixon's Navigation	1·21	Nixon's Navigation	1·26	Nixon's Navigation	1·19	Nixon's Navigation	1·205
Elands-laagte	1·09	St. George's	1·05	Natal Navigation	1·03	Natal Navigation	1·04
St. George's	1.08	Natal Navigation	1·04	Elands-laagte	1·03	St. George's	1·04
Dundee	1·03	Glencoe	1·03	St. George's	1·02	Glencoe	1·02
Utrecht	1·02	Dundee	1·01	Glencoe	1·01	Elands-laagte	1·00
Natal Steam	1·01	Elands-laagte	1·00	Dundee	1·01	Durban Navigation	1·00
Natal Navigation	·97	Utrecht	·98	Utrecht	·97	Dundee	·99
Glencoe	·96	Durban Navigation	·96	Natal Steam	·96	Utrecht	·98
Durban Navigation	·96	Natal Steam	·95	Durban Navigation	·96	Ramsay's	·95
Ramsay's	·88	Ramsay's	·91	Ramsay's	92	Natal Steam	·92
Newcastle	·85	Newcastle	·87	Newcastle	·89	Newcastle	·92
Zululand	·93	Zululand	·85	Zululand	·81	Zululand	·88

A Reid boiler under light-draught conditions probably represents closely those of a good marine boiler.

Speed of Steaming with Reid Boiler.

Natural Draught.		Light Draught.		Medium Draught.		Full Draught.	
Durban Navigation	1·145	Glencoe	1·17	Ramsay's	1·22	Utrecht	1·18
Ramsay's	1·12	Ramsay's	1·16	Glencoe	1·13	Ramsay's	1·01
Utrecht	1·07	Natal Navigation	1·15	Durban Navigation	1·12	Natal Navigation	1·08
Natal Navigation	1·05	Durban Navigation	1·14	Natal Navigation	1·12	Durban Navigation	1·07
St. George's	1.04	Welsh Coal	1·10	Newcastle	1·10	Dundee	1·07
Newcastle	1·03	Newcastle	1·09	Welsh Coal	1·05	Newcastle	1 06
Glencoe	1·02	Dundee	1·06	Utrecht	1·03	Glencoe	1 02
Welsh Coal	·98	Utrecht	1·00	Dundee	·99	St. George's	·98
Dundee	·94	Natal Steam	·86	Natal Steam	·89	Welsh Coal	·93
Natal Steam	·93	St. George's	·86	St. George's	·83	Elands-laagte	·84
Elands-laagte	·90	Elands-laagte	·81	Elands-laagte	·83	Natal Steam	·82
Zululand	·56	Zululand	·57	Zululand	·50	Zululand	·45

Amount and Nature of Residue.

Name of Colliery.	Ash.	Clinker.	Smoke Box Dust.	Total Residue.
Welsh Coal	6 71	·99	1·09	8·81
Utrecht	5·56	2·78	1·07	9·41
Natal Navigation	8·95	1·87	1·35	12·17
Newcastle	9·55	1 91	·79	12 26
Durban Navigation	9 66	2·97	·72	13·35
St. George's	9·31	3·04	1·05	13·40
Dundee	9·31	3·03	1·32	13 67
Glencoe	10·34	2·55	·92	13 82
Ramsay's	10·54	3·72	·79	15 06
Elandslaagte	14 69	3·02	·76	18·47
Natal Steam	14·90	3·79	·91	19 60
Zululand	20·62	6·32	·80	27·74

Early Days in the Mining Districts



View of Barberton in 1888



Pilgrims Rest in 1888

With regard to smoke, as a result of observations based on Admiralty rules, the collieries were classified as under: Zululand, being anthracitic, of course came first, then others followed as under: Welsh coal, Dundee, Natal Steam, Utrecht, Elandslaagte, Ramsay, Glencoe, St. George's, Natal Navigation, Newcastle, and Durban Navigation. When the above tests were made the present Hlobane and Utrecht Collieries were not developed to their present extent and are not, therefore, included in the list.

In addition to the above tests made by the Natal Government, several have also been made by the Natal Government Railways for locomotive purposes, of which the following results have been published:—

Name of Colliery.	Quantity of Coal Tested. Lbs.	Consumption per Mile. Lbs.	Refuse from Fire Box. Per cent.	Water Evaporated. Gallons.
Natal Navigation	2616	67·07	10·24	2002
St. George's	2800	71·79	12·75	2324
Dundee	2761	70·79	13·07	2282
Elandslaagte	2856	73·23	19·25	2450
New Campbell Colliery	4704	120·61	25·24	2632

These tests were made under precisely the same conditions, over an identical length of railway, and for purposes of comparison may be considered reliable. The results obtained at the New Campbell Colliery are included so as to show the value of the semi-bituminous coal deposits in Natal, which cover such extensive areas, and to-day are deemed to be of comparatively little value as compared with the standard quality of steam coal now worked in Natal. The evaporative efficiency of the New Campbell Colliery coal, according to these results, is only about sixty-seven per cent. of the Dundee coal, for instance. A test of Hlobane coal by a "Dubs A" locomotive on March 10th, 1910, gave a consumption of 53.52 lbs. of coal per mile, a speed of burning per square inch of grate and per hour of thirty-nine; and an evaporation of ten pounds of water per pound of coal.

ORANGE FREE STATE

Quality of Coal.

The quality of the coal worked in the Orange Free State varies in somewhat the same manner as Transvaal coals, but perhaps not to the same extent, and may, to all intents and purposes, be considered as an extension of the Transvaal coal fields. The coal worked so far to any extent represents the Transvaal second grade, rarely exceeding an evaporative efficiency of ten.

The best coal at present worked in the Orange Free State is probably obtained from the coal field south of Klerksdorp and known as the Vierfontein coal field. The bulk of the output is, however, obtained from the Cornelia and Coalbrooke Collieries, along the Vereeniging-Bloemfontein line, the mileage to the Rand, however, being too great, considering the quality of the coal, to enable them to compete with Middelburg coal for steaming purposes, although for household consumption the Orange Free State coal is much liked.

The Vierfontein coal is almost exclusively taken by the De Beers mine of Kimberley, who own a controlling interest in this colliery.

The following tests of the Vierfontein and other coals were made at the Kimberley Exhibition in 1892:—

Name of Colliery.	Weight of Water evaporated from and at 212 F.	Value of Coal, taking Welsh coal at 100.
Vierfontein, (Orange Free State)	6·49	60·4
Indwe (Cape Colony)	5·94	55·2
Jones & Blount ,,	5·63	52·4
Molteno ,,	5·52	51·3
Cyphergat ,,	5·42	50·4
Fairview ,,	5·13	47·7
Vaal Drift (Transvaal)	5·02	46·7

Other practical tests made at De Beers mine were as under:—

No. 1.

Name of Colliery.	Lbs. of Water Evaporated per lb. of coal consumed	Comparative Values.
Nixon's Steam Navigation (Welsh)	11·0	100
Newcastle Colliery (Natal)	9·5	81
Vierfontein (Orange Free State)	7·0	60
Vereeniging (Transvaal)	6·7	57

No. 2.

Detailed Tests of Vierfontein Coal at De Beers Mine.

	Screened Coal.	Unscreened Coal.	Single Screened Coal.
Length of Test	9 hours	9 hours.	9 hours.
Quantity Used	8,890 lbs.	12,272 lbs.	11,775 lbs.
Weight of Ashes	2,217 lbs.	2,725 lbs.	2,756 lbs.
Per Cent. Ashes	25%	22%	23%
Average Steam Pressure	114 lbs.	115 lbs.	114 lbs.
Evaporative Factor	1·055 lbs.	1·17 lbs.	1·166 lbs.
Lbs. Water Evaporated	52,560 lbs.	56,400 lbs.	54,900 lbs.
Per lb. Coal	6·237 lbs.	5·38 lbs.	5·43 lbs.

No. 3.

Coal Tests at Kimberley.

	English Coal.	Vierfontein Coal.	Cyphergat Coal.
Duration of Test	8 hours.	8 hours.	7½ hours.
Average Steam Pressure	95 lbs.	101 lbs.	99 6 lbs.
Average Temperature of Feed Water	133° F.	139 lbs.	137° F.
Coal Consumed	1,696 lbs.	1,968 lbs.	2,660 lbs.
Cinders after Test	121 lbs.	125 lbs.	236 lbs.
Clinker Average	10 lbs.	160 lbs.	392 lbs.
Ash Average	71 lbs.	128 lbs.	364 lbs.
Coal Actually Consumed	1574 lbs.	1,842 lbs.	2,424 lbs.
Refuse in Coal	5%	15%	31%
Lbs. of Water Evaporated	15615 lbs.	15215 lbs.	14304 lbs.
Lbs. of Water per lb. of Combustible	10	8	6
Value per cent. of English Coal	100	83	59

CAPE PROVINCE

Probably the worst coal worked in South Africa is in the Cape Province in the neighbourhood of Stormberg, where coal has been worked for many years principally to supply the Cape Government Railways and De Beers with coal when coal of better quality from other coal fields was either not available or too expensive to use. Professor Green gives the following as an average analysis of Molteno coal: Carbon, 60.89 per cent.; volatile matter, 10.31 per cent.; ash, 28.80 per cent.; moisture, 1.13 per cent.; sulphur, .76 per cent.

The reason why the coal is so inferior will be found in the high ash and low volatile contents. Many coals in the Transvaal have been worked with equally high ash contents and much less fixed carbon, but the lack of volatile matter makes the coal, for steam purposes, a very inferior one indeed. Some of the coal from Delmas, in the Transvaal, gives a similar result, but in other cases in the Cape Province the fixed carbon is as high as seventy per cent., the ash running from twenty and thirty per cent., whilst the volatile matter scarcely ever exceeds ten per cent. Most of the coals clinker and require so much attention in use that the stokers on the railways, being closed with other "hors de combat" for days together, the railways, collieries in the Cape Province their principal down owing to their inability to be the equivalent South African coals, for which for some time past market. The Cape co

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Kenilworth Castle	12,975	Dunvegan Castle	6,117	Galeka	6,767	Comrie Castle	5,167
Armadale Castle	12,973	Dunottar Castle	5,625	Galician	6,757	Cluny Castle	5,147
Walmer Castle	12,546	Dover Castle	8,271	Gascon	6,298	York Castle	5,310
Saxon	12,385	Durham Castle	8,217	Gaika	6,392	Corfe Castle	4,592
Steamer (building)	11,000	Dunluce Castle	8,114	Goorkha	6,300	Aros Castle	4,460
Briton	10,248	Gloucester Castle	7,999	Braemar Castle	6,280	Gordon Castle	4,408
Kildonan Castle	9,692	Guildford Castle	7,995	Guelph	4,890	Sabine	3,'05
Kinfauns Castle	9,664	Galway Castle	7,988	Goth	4,791	Susquehanna	3,711
		Garth Castle	7,610	Cawdor Castle	6,235	Hansa	879

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of Komati Poort and the so-called anthracites of the Transvaal found near Ermelo and in basins in the dolomite country between Springs and the Middelburg coal field.

Several tests have been made by the Cape Government Railways with Cape, Transvaal, and Welsh coals, from which the following comparative results have been extracted :—

Results of locomotive tests made with Welsh and South African coals in Cape Colony in 1897-8 :—

Colliery.	Total Quantity of Coal Consumed.	Consumption of Coal per Ton per Mile.	Evaporation of Water per 1 lb. of Coal.	Comparison 1 Ton Welsh equal to
	Lbs.			Tons.
Welsh Coal	47,490	·297	8·84	1·000
Indwe	103,500	·536	5·35	1·634
Viljoen's Drift (Transvaal)	98,925	·414	5 91	1·564
Orsmond	98,400	·444	5·69	1·554
Indwe (Picked)	32,500	·511	5·65	1·564
Indwe (Inferior)	19,350	·589	4·73	1·868
Cyphergat	109,800	·523	5·00	1·729
Fillingham's Wallsend	25,050	·589	5·22	1·582
Fairview	81,450	·596	4·93	1·715
Molteno	27,000	·608	5·12	1·706
Fairview (New Mine)	30,150	·520	4·90	1·904
Guba	15,300	·588	4·94	1·789
Contat's	24,600	·406	6·21	1 554
Dr. Smut's	43,500	·955	3·41	3·679
South Rand Exploration (Transvaal)	24,150	·406	5·93	1·525
Penshaw	25,200	·484	5 58	1·591
Victoria Colliery	33,300	·546	4·23	2·103
Cape Collieries	31,500	·494	4·66	1 989

Resources of the Coal Fields.

There are few countries probably in the world where such an extensive area is covered by coal measures, productive and otherwise, as is the case with South Africa. Except in the Cape Province, the workable coal seams are confined to the Beaufort beds, and this reduces the coal-producing area by probably over one-half. Then the coal seams run flat, or nearly so, which again makes the yield, compared with the area, low, whilst again a proportion of the Beaufort beds do not carry coal, and where the Beaufort beds do carry coal, only a small portion produces coal of equal standard to the best sold to-day either in the Transvaal or Natal.

The Transvaal has the largest area of productive coal measures of any Province in the Union, over four thousand square miles in extent, not including the worthless Stormberg beds at Komati Poort and those north of Pretoria. Less than one-tenth of this area has been proved to carry coal equal to the present Middelburg standard of a theoretical calorific value of 12.50, nearly the whole of this extensive area containing coal ranging from a theoretical calorific value of ten to twelve, and therefore of second-rate quality. Another ten per cent. runs under ten, and includes the inferior coal lying between Boksburg and the Wilge River, as also the scattered inferior coal deposits near Delmas, most of which carry coal far too inferior to use for steam purposes under to-day's requirements.

Next in area comes the Orange Free State, having an area of only a thousand square miles less than the Transvaal of Beaufort beds estimated to be capable of yielding a serviceable steam coal, but the quality is mostly third-rate as compared with the Transvaal gradings of coal to-day, and much of it is too inferior to be of any service.

There is also an area of about two thousand square miles of coal measures in Natal, but only a fourth of this extensive area is estimated to represent productive coal fields. Then again, less than a third of this area contains workable coal, and much of this is unserviceable. The result is, that in Natal, only a very limited area indeed carries coal of what is considered as standard quality for shipment and market purposes, there being less coal of standard quality in Natal than of the Witbank coal field standard in the Transvaal. In Natal, most of the coal is too anthracitic to be considered to be of any value to-day.

The coal resources of the Cape Colony are very limited, being confined to the Stormberg beds, where the coal occurs in such an irregular manner that a reliable estimate is very difficult to make.

The following is an estimate of the coal resources of the different Provinces reduced to figures, showing the probable number of marketable tons of coal of different qualities as graded in the different Provinces to-day :—

TRANSVAAL.

Witbank Theoretical Calorific Value. Exceeding 12	Second Grade Theoretical Calorific Value. From 10 to 12.	Third Grade Theoretical Cal rific Value. From 7 to 10.	Total Tons of available Coal under to-day's conditions.
Tons 529,920,000	Tons. 5,093,092,000	Tons. 576,000,000	Tons. 6,199,012,000

ORANGE FREE STATE.

Theoretical Calorific Value. Over 9.	Theoretical Calorific Value. From 7 to 9.	Total.
Tons. Say 1,000,000,000	Tons. 4,529,000,000	Tons. 5,529,000,000

NATAL.

Standard Quality Theoretical Calorific Value. Over 13.	Second Quality Theoretical Calorific Value. Between 12 & 13.	Third Grade Semi-Anthracite. Unmarketable To day.	Total. Saleable Coal.
Tons. 290,000,000	Tons. 340,000,000	Not Estimated.	Tons. 630,000,000

The Cape Province probably contains one hundred and fifty million tons of coal, but it is much too inferior



Outspan Mine, Witbank Colliery; Another View

in quality to be classed with even the third-grade qualities of coal of the Natal and Transvaal, and may be considered to add but little to the coal resources of South Africa. In all the other Provinces there are considerable tonnages of coal superior to Cape coal altogether left out of the above estimates as unsaleable to-day, but which in the distant future may be of some value.

Several estimates of the coal resources of the Transvaal have been made, but they have not attempted to classify the coal as to quality based on present-day conditions. A writer in "New South Africa" estimated the quantity at sixty thousand million tons by taking an average thickness of ten feet throughout. As there are large areas included in this estimate where no coal exists, and other large areas where the coal is not saleable, it errs considerably on the side of area. Ten feet is also an excessive thickness to take, even if all the coal, inferior and otherwise, is to be included.

Mr. R. N. Kotzé, the Government Mining Engineer, in his address before the local Institute of Engineers in August, 1911, took the area of the coal fields at five thousand square miles, with an average thickness of six feet, and allowing fifty-five per cent for extractable, saleable coal, fixed the total at twenty thousand million tons. This area is excessive, and makes inadequate allowance for a somewhat extensive area where no workable coal has been proved. An average thickness of six feet of saleable coal is also too much to expect over such an extensive area, but this estimate is far nearer the mark than the one contained in "New South Africa."

If, however, only saleable coal under to-day's conditions is to be counted, this estimate is about three times too great, but in the future, as conditions change, a more inferior coal will perforce be used. Under this classification will come much of the coal now left as roof coal on account of its inferior quality, and some of the so-called anthracitic coal in the neighbourhood of Delmas and the inferior coal near Belfast and Komati Poort. The most striking feature of the Transvaal coal fields is the large proportion of coal resources inferior to the present Witbank standard quality.

The Orange Free State coal fields carry, for the most part, a second-grade coal which, under existing conditions, does not find a ready sale.

The Natal figures are interesting because they show how, after all, the coal of present standard, for shipping purposes, is really of very limited extent, and the really small proportion of saleable coal to be found in such an extensive area covered by the Karroo formation. Even under the present method of working, it is doubtful whether anything like the estimated tonnage of coal of to-day's standard quality will be worked in Natal, where to find an attractive coal field of this description is not an easy matter. The resources of semi-bituminous and inferior anthracitic coal, unsaleable to-day, are, however, very extensive.

Probable Life of the Coal Fields.

The "life" of the coal fields depends upon so many future conditions that it is impossible to estimate the duration of the coal supply. Generally speaking, since the gold mines got in proper swing after the war, the output of coal has doubled itself in ten years, and there seems every prospect of this condition of affairs being continued. If an adequate reduction be made on railway rates for export coal, then the increase will be even more marked both in the Transvaal and Natal. There is, however, one thing certain, and that is if the same practice exists as to-day of working as much of the coal of the Witbank standard of quality as possible, this quality of coal will be long exhausted before the Rand and the mines will be running on coal of second grade. The same thing will happen in Natal as regards bunker and export coal, the supply of which is smaller than generally admitted. Fortunately, however, both the Transvaal and Orange Free State possess large reserves of second-grade coal quite good enough for general purposes even when the supplies of Witbank standard quality have been exhausted.

A Successful Natal Colliery Company

Natal Navigation Collieries and Estate Company, Limited

THE Natal Navigation Collieries have been amongst the most successful in South Africa. They are situated about five miles from Hatting Spruit Station, Natal, and two hundred and forty miles from the port of Durban. The company was originally known as the "Natal Navigation Collieries, Ltd.," and was formed to work coal areas selected with much discrimination and good fortune by Messrs. Dundas Simpson and Richard Sneddon. The original capital was £150,000. In 1902 the old company was merged in the new, with an authorised capital of £425,000, of which £408,000 was issued on taking over. Subsequently another eight thousand shares were issued to acquire coal-bearing ground on the farm St. George. There are at work two complete pits, about a mile apart, fully equipped with modern screening and picking machinery, and with washing plants of the "Bash" type. A third, but smaller, pit is in course of equipment and will be ready for output in September, 1912. Under full and normal working conditions the output capacity will exceed forty thousand tons of two thousand two hundred and forty pounds monthly. From its formation in 1897, the company has aimed at making the best of the exceptionally good coal it possesses, and the up-to-date equipment provided has led to a general improvement in the equipment of Natal collieries, with a consequent improvement in the general quality of Natal coal. The company also produces coke to a limited extent, making and selling some two hundred and fifty tons monthly. The property consists of seven hundred and ninety-one acres, held in freehold, and coal

rights over an additional five thousand eight hundred and twenty-two acres.

The company's output from April, 1898, to the end of June, 1912, has been two million eight hundred and eighty-eight thousand tons, and during this period they have paid in dividends the satisfactory and substantial sum of £405,800. A large portion of this amount was paid during the war, when exceptional conditions justified and made possible high selling prices. The following annual record of the dividends paid will be interesting :—

1900	£29,000
1901	59,500
1902	60,375
1903	40,500
1904	20,250
1905	30,975
1906	20,650
1907	20,650
1908	25,812½
1909	25,812½
1910	25,812½
1911	30,975
1912 (half-year only)	15,487½
	£405,800

Financially, the company is in a very strong position. Notwithstanding the large dividend distributions, the company has some £120,000 cash reserves on fixed deposit at South African banks. The company has spent over £220,000 in cash on the opening out, development, and equipment of its properties. Of this, £133,125 was raised by share issues, and the balance was supplied by current revenue. The whole of the assets covered by the cash outlays have been liberally written off from time to time, and the whole of the assets (excluding cash and property account) stand at the low valuation of £98,000 in the balance sheet for the year ended June 30th, 1911.

Quality of Coal.

The quality of the company's coal has long been regarded as the standard quality of Natal and of the whole of South Africa, which easily explains the company's successful career. They have supplied largely the Cape Government Railways with a part of their oversea requirements, and in this connection it is interesting to note that the efficiency of the coal obtained by practical tests has been very high. The company secured, not long ago, an increase of 1s. 6d. per ton on the contract price owing to the efficiency obtained exceeding the guaranteed minimum of 8.2 lbs. of water per lb. of coal (60°F.). The company have from time to time held some of the most important contracts open to Natal trade. A few years ago they secured the oversea supply of coal for the Ceylon Government Railways, and they have always held a large share of the supply of the railways in Natal. For some years the daily mail corridor train between Durban and Volksrust has been run practically exclusively with the company's coal. In regard to theoretical efficiency, the coal has given from 14.5 to 15.2 lbs. of water per lb. of coal by Mahler Bomb. It will thus be seen that the company produces one of the best coals in South Africa for steam-raising purposes, and the washed small coals, such as nuts and peas, are well adapted for smithy use, of which large quantities are sold in Johannesburg. The company has a substantial export trade, but this at present is not being developed to its fullest extent, and it is in this direction that the company mostly looks forward for expansion. At present the great bulk of the coal is sold in supplying ships' bunkers at Durban and Cape Town. The company has held the foremost place in Natal in regard to output and dividend distribution, and stands alone in being free from all debenture or loan obligations, and having at the same time a cash reserve of exceptional amount.

Prospects and Policy of Transvaal Coal Owners

A Review of the Outlook for the Industry

THE Transvaal Coalowners' Association was formed to stop the cut-throat competition amongst the colliery companies, and not with any idea of unduly raising prices to consumers. What the association has attempted to do is to steady prices with a view to obtaining for investors in colliery properties a fair return on money invested. One of the benefits of the co-operation has been to reduce working costs at the collieries, as the mines have been able to count on fairly steady outputs, and from this again the public has also benefited, as the collieries have been able, while making a profit, to sell at lower prices to consumers. An export trade and bunkering trade, also, can only be done satisfactorily by a co-operation of collieries. The coal mined in the Witbank district is practically uniform in quality, so that it is possible to draw from a number of collieries for the same shipment, thus expediting the business. If there were no co-operation, and coal were being sent to Delagoa Bay by each colliery for separate steamers, there would be endless confusion and delays. The association has been endeavouring to build up an export trade through Delagoa Bay, that being the natural port for the shipment of Transvaal coal. There are large markets in India and the East into which Transvaal coal should be able to gain an entry and in which it should do a large business. The collieries have, even at a loss, sent trial cargoes to Indian ports, and the coal has been very favourably reported upon. It has been found, however, that Transvaal coal landed in India costs just about two shillings per ton more than the figure necessary to get a share of the trade, and the coal-owners have for a long time urged the Government to concede a reduction of two shillings per ton in railway

rate to the coast. The Government has granted a rebate of one shilling per ton on coal for export, to take effect as from August 1st, 1912, but it is clear that this cannot materially assist the collieries. A reduction of two shillings per ton in the railway rate would probably enable the coal-owners to secure large contracts in India, when, of course, cheaper rates of shipping freight could be obtained for regular shipments than have at present to be paid for chance steamers. It should be recognised by the Government that, while pushing the coal trade in Union ports, Delagoa Bay, although a foreign port, is the nearest and most natural outlet for the export of Transvaal coal, and that the bunkering of steamers with Transvaal coal at Delagoa Bay should also be pushed for the benefit of the Transvaal. It will be remembered that some time ago, on behalf of the Railway Board and the collieries, Mr. Gordon Sandilands visited all the Eastern ports with the object of finding markets for Transvaal coal, and extracts from his report have been published. He estimates that Bombay and Karachi purchase annually about two million tons of sea-borne coal, and, provided our price was satisfactory, a considerable and increasing tonnage of Transvaal coal could be sold. To summarise the position, it may be said that the East African trade north of Delagoa Bay is at present very limited, but likely to increase at an early date, as timber adjacent to the railways is becoming scarce and expensive. If the Transvaal is to secure any of the trade in the Indian Ocean, a further material reduction in railage is essential. The collieries have expended large sums in trial shipments and the coal has proved satisfactory—price alone nullified their efforts. Indeed, the whole question of the future of the export of coal from the Transvaal coal fields is in the hands of the Railway Administration. There is no hope of such a trade being established unless the railway rates on coal are reduced to a figure which will allow of Transvaal coal being placed on the Indian market at an attractive price. All other essentials are present —a good coal, a regular supply, backed up by sound guarantees. Great efforts were made by the first Association to endeavour to secure a portion of this Indian trade, and high hopes were entertained, but the results have proved that while everything else was favourable the price was excessive. All the points of expense were examined, and the only item which can be materially reduced is the railway rate. If a reduction can be effected, there is before the Transvaal coal fields an era of prosperity which would naturally be reflected in the country. The question of reduction of the rates should be considered on the broadest possible lines—of the great benefits which will accrue to the country generally, rather than on the single point of railway economy. There is a market for the coal, and every effort must be made to open this market for the benefit of the Transvaal.



Witbank Colliery; Another View



Hlobane Colliery. Mechanical Haulage in "Alfred" Seam Adit.
(Coal showing on sides of Adit.)

A New Era in Agriculture in South Africa

The Vast Possibilities of Intensive Cultivation

By H. P. GORDON

THE legislative achievements of the recent session of Parliament, in matters intended to promote agricultural expansion mark a departure from South African traditional points of view almost revolutionary in character. Less than two years ago no one was sanguine enough to believe we were so near to a definite

National Policy

of land settlement as recent events have demonstrated. And now that a commencement has been made in the formulation of a policy by which the possibilities of agricultural development are made more real, the scope of that policy will widen as its influence spreads. One successful settlement of farmers upon holdings relatively small will convince conservative landowners that farming pays best when the soil is converted to the production of high-priced commodities, and that their lands will treble and quadruple in value as the resources of the small farm are developed.

The Acts relating to land settlement, irrigation, and State loans to farmers raise visions of most hopeful augury for the future of the Union. These Acts personify a national

Policy of Development

South Africa has long cried out for. And, seeing that our lawgivers have placed their hands to the plough, they cannot well turn back. The history of land settlement in all new countries shows us that the foundation of the prosperity of such countries is linked indissolubly with the efficient cultivation of the soil. Easy access to the land, a reliable water supply, and command of the necessary capital are fundamental essentials in the evolution of a great agricultural system. Our Parliament has made a beginning in these directions, and the advance already made is pregnant with vast possibilities in the immediate years to come. For many years in Canada land settlement was stagnant. In Australia and New Zealand the early ventures of land settlement legislation met with a poor response. As in those countries the weaknesses and defects of their first-tried experiments soon made themselves manifest, so will it be with us. The pressure of demand for revised and extended

Remedial Legislation,

which local exigencies create will compel our Parliamentary rulers to take further action from time to time to render more available the opportunities for the acquisition of suitable farm lands. It remains to be seen whether the authorities by which these various Acts are to be administered will try and profit by the most recent experience of other countries and avoid the mistakes those countries made in the experimental stages of their land settlement and irrigation schemes. If the industry of agriculture be served first, and the interests of individual landowners be made a matter of secondary concern, we shall soon gather the first fruits of an improved and efficient system of agriculture.

A prolific cause of failure in the earlier closer settlement ventures of Australia was the

Unsuitability of the Locality.

In irrigation schemes, the original projects came to grief in New South Wales and Victoria through the holdings being too large. It follows, as a matter of course, that if the locality be unsuitable and the holdings too large for efficient and profitable management, the loans made by the Land Bank, on the security of such lands, will have been thrown away and become a loss to the State. It is, therefore, a matter of paramount importance that locality should be considered first in any contemplated proposal for the acquisition of land for the purposes of closer settlement. And where such a settlement is to depend upon irrigation as the source of its water supply, a fatal mistake will be made if the farms be so large that only a comparatively small part will be cultivated. The larger the holding the more is the difficulty enhanced of effective personal supervision; while the problem of procuring an adequate supply of labour when the harvest is to be reaped is rendered more acute.

The most profitable system of farming to-day is that known as

Mixed Farming.

By such a system the farmer enjoys a more or less regular cash return throughout the year as the reward of his industry. But mixed farming is only practicable in localities adjacent to a city and where transport by rail is available. As an example of the profitable nature of mixed farming, the following case is taken from a number of illustrations supplied by the Agricultural Department of Victoria. In June, 1909, a farmer acquired a fifty-acre holding in the Cohuna Estate, subdivided by the Closer Settlement Board. It was within an irrigated area. It cost him fifteen shillings an acre to clear the land of scrub. He built a simple one-roomed hut as a habitation. The only labour

employed was his own and that of

One Other White Man.

He put down two acres of tomatoes under glass ; ten acres under lucerne ; eight acres were laid out as an orchard, mainly apples and pears for export ; three acres were sown in mealies ; one acre to potatoes ; a quarter of an acre under beans ; three acres cauliflowers. On the lucerne he expected to keep five hundred sheep and to raise fat lambs for the London market. His gross returns for the first year were nearly £700, the result of two men's work. When his orchard is in full bearing and the area under cultivation increased, this farmer calculates that he will have no difficulty in making a clear net profit of at least

A Thousand Pounds a Year

from his fifty acres. This example is not an exception. Numerous other similar instances are given. Some of them show that farmers diversify their industry between fruit growing, dairying, bee-keeping, and poultry farming, besides cultivating part of their land in lucerne and vegetables. Tomatoes and asparagus are vegetables which lend themselves easily to canning, and in this form may be exported in large quantities at payable prices. Californian canned asparagus may be had in Johannesburg to-day.

But there is no reason to go outside South Africa for examples as to the large profits the soil can be made to yield when efficiently cultivated by intensive methods. The pamphlet lately issued by the Cape Peninsula Publicity Association affords ample proof of the suitability of the soil in parts of the Western Province for farming on small holdings. Farmers there are getting a gross return of from £1,500 to £2,000 a year from less than one hundred acres laid out as vineyards. Fruit drying in that district is becoming a highly important industry. The market for raisins and dried fruits is practically inexhaustible. The value of such an industry to this country may be imagined from the fact that for the year 1909 the output of dried fruits, exclusive of prunes and raisins, of California was nearly

Forty Thousand Tons;

and of prunes and raisins, one hundred and forty-eight thousand tons. When the fruit farmers of the Western Province realise the inestimable value of co-operative action, and establish canning factories for the disposal of their surplus fruit and vegetables, there is no earthly reason why the Western Province should not become a second California and raise from its vineyards, orchards, and market gardens over £20,000,000 a year. The products of the vineyards, orchards, and vegetable gardens of California for 1909 "marketed by the producer and for the most part shipped out of the State" (vide Californian Board of Trade Report, 1909, p. 44) "amounted to nearly $120,000,000, say £25,000,000 sterling. The figures are so huge that I feel bound to emphasise the fact that they exclude the products of grain-farming, dairying, poultry farming, etc., and are confined strictly, in tabulated form in the Board of Trade Report, to "orchard products, vineyard products, and garden products." Mildura, the once despised and bankrupt irrigation settlement of Victoria, now sends away about £175,000 worth of canned and dried fruits per year. When the possibilities of dairying, grain, tobacco, etc., are added to the resources of the Western Province, we begin to get a faint idea of the immense prospective wealth the rich soils of that fertile region holds. I have cited the Western Province because authentic data of its possibilities are supplied by the admirably compiled pamphlet already referred to. There are many other parts of South Africa possessing all the essentials for high farming on small holdings. There are districts of the Transvaal, of the Free State, and

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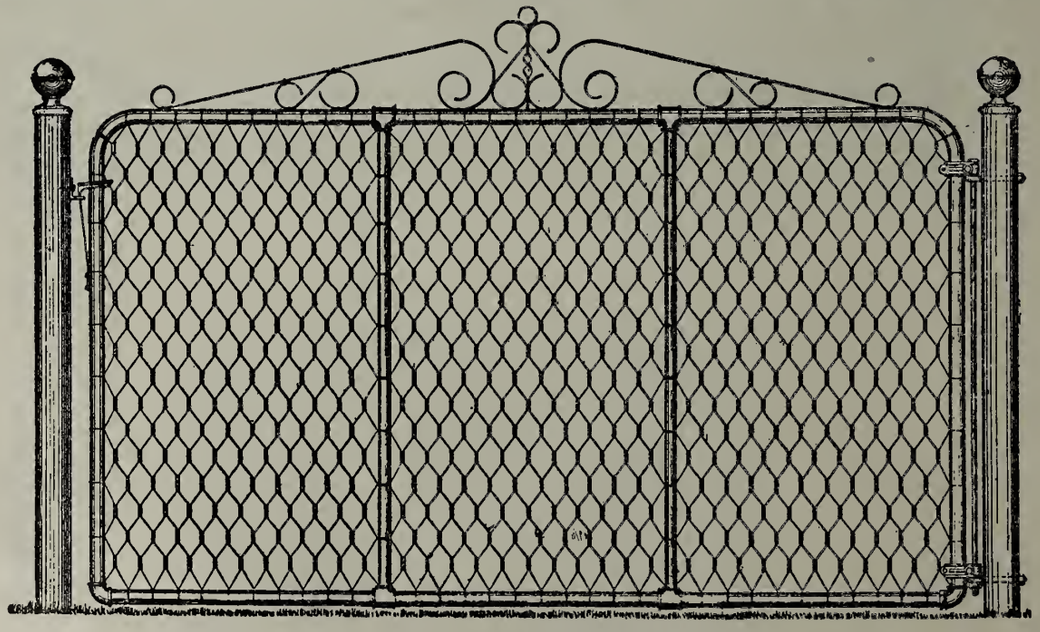


Illustration of the "CYCLONE" GATE (of which there are thirty stock sizes) made of steel wire, woven by hand on to frames of steel tubing.

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Natal capable of producing in rich variety inexhaustible supplies of foodstuffs. In mealie-growing we flatter ourselves we have done well by exporting some 150,000 tons of mealies in a single year. The Argentine exports about

Five and a Half Million Tons

of mealies per year.

Facts like the foregoing should convince us all of the incalculable value of the magnificent asset South Africa possesses in her fertile lands and climate. And if that asset be wisely utilised by the widest range of exploitation possible, the time is not far distant when our farm lands will yield a larger aggregate return in value per year than any other industry within the Union. But much depends upon the way our recently enacted land settlement and irrigation laws are administered. If the powers these Acts confer are used in a narrow and restricted spirit, a great opportunity will be strangled.

As regards irrigated farms, Mr. Elwood Mead, the well-known irrigation expert of Victoria (and formerly chief of the Irrigation Investigation Branch of the United States of America Department of Agriculture), says that



Agricultural Show Ground, Johannesburg, Railway Siding

"experience has shown that compact areas, and close settlement of such areas, are two essentials of successful irrigation." Compact areas minimise the risk of extravagance in the use of water, while the closer together the irrigated farms are the more economically can the settlement be run as regards labour. The average farm unit in many irrigated countries, with natural advantages no greater than those of South Africa, does not exceed twenty acres. It has been abundantly proved in Victoria that irrigated holdings of

Two Hundred Acres

invariably result in failure and disappointment. The present policy in that State is to confine the holdings to small areas averaging about one hundred acres each, and to restrict the supply of water, approximately, to two acre-feet for each acre of land. The advantages of having a body of farmers in close and daily touch with each other are obvious. Though each pursues his calling in his own way, methods of co-operation will gradually be adopted as the farmers learn from experience and intercourse with each other the many ways in which co-operation promotes efficiency and reduces the cost of production.

Farm settlements in the interior would depend, mainly, on grain-growing and stock-raising, and the farm unit would, necessarily, be very considerably larger than the areas of farms adjacent to a port. What is possible of accomplishment in districts of the interior is exemplified by the remarkable development of agriculture in the western districts of Canada. It is estimated that in less than twenty years from last year there will be

Fifty Million Acres

under cultivation in the western provinces of Canada: that the production will be nine hundred million bushels of wheat. To harvest this crop it will require six hundred and twenty-five thousand farm workers at an estimated wage of thirty million dollars. Twenty thousand trains, of forty cars each, will be needed to transport the crop. Its value, at three shillings and four pence per bushel, would be seven hundred and twenty million dollars, say, £145,000,000 sterling. Our farmers, when contemplating the immensity of these figures, need have no fear of over-production. The increase in the bread-eating population of the world, in the meantime, will ensure a ready market for all the wheat then available.

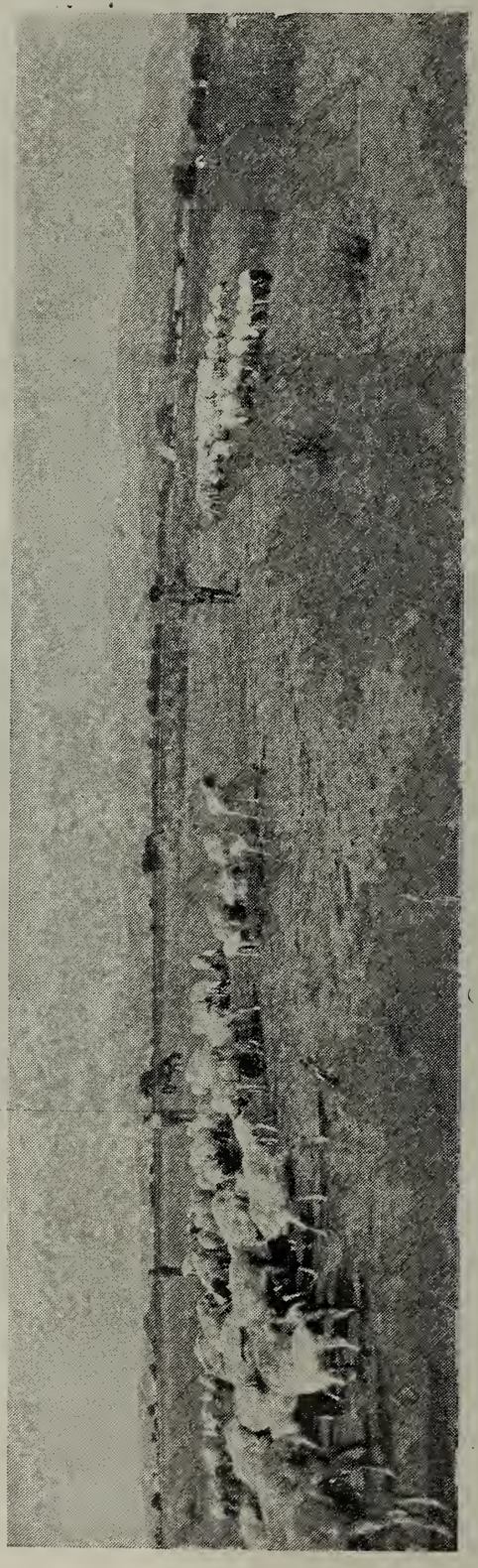
Share-farming is quite a common business in parts of Australia. Under this system landowners have found it to their interest voluntarily to subdivide their holdings into convenient areas suitable to the locality, soil, and climate.

The Landowner

practically becomes the landlord, and receives his share of the gross returns as an equivalent for rent. This system obtains mostly in the wheat belt. The landowner provides the land; the tenant finds all the implements and horses necessary to work the land, and also the labour. The crop is equally divided. On some estates the tenant receives as much as two-thirds or three-fifths of the total yield. Each party finds the bags needed for his own share of the crop. Occasionally the landlord supplies all the seed. The practice of share-farming is also very common in dairying.

In South Africa, where landowners are averse to selling any part of their holdings, agriculture could be

Some Transvaal Farm Views



Persian Sheep on One of the Transvaal Consolidated Land Company's Farms



Ostriches on Lucerne on Transvaal Consolidated Farm Rondeboschje, near Potgietersrust

greatly advanced by farming on the share system. If the rural landowner himself is not disposed to cultivate his land, he would incur no risk under a system of farming "on the halves." To the landowner himself the advantages of a policy of agricultural expansion are manifold.

The Value of His Land

would increase enormously under the influence of methods which test to the full the real economic worth of his land. His income would be more than quadrupled from the increased profits per acre the soil is made to yield. And the more beneficial exploitation of the wealth his land holds would quicken the activities of industry in every branch of trade. Agricultural development is the talisman by which new possibilities will be unfolded in the march of industrial progress in South Africa. Every additional farmer

Cultivating His Land

and building up new stores of capital in the wealth he raises, creates new wants and increases the demand for farm implements, building material, fencing, and other articles needed for the proper equipment of his farm. The business of the manufacturer and merchant is increased in satisfying his wants. As the merchant and manufacturer prosper, the position of their employees is made more secure. And the prosperity of one branch of trade reacts upon others. Over the whole wide field of industry the influence of agricultural prosperity is, more or less, directly felt. It will easily be realised, therefore, what vast potentialities for good the legislation of the late session makes possible if carried out in a broad and statesmanlike spirit.



Produce Section, Agricultural Show Ground, Johannesburg

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Mixed Farming in South Africa

Smaller Areas and Better Cultivation :: Food Values :: Lucerne a Staple Food
How to Balance Food Rations :: How to Obtain the Maximum Returns from the Soil :: Stall Feeding Cattle

By W. T. SECCOMBE

THERE are comparatively few farmers in South Africa who specialise or, in other words, carry on one branch of farming operations to the exclusion of all others, as is the case in Australia, where the man on the soil is either a pastoralist, i.e., a man who devotes his entire area to grazing stock, or an agriculturist who specialises in the production of cereals, fruit, or some other product. The Australian farmer specialises because it pays. He finds out which crops are best suited to his soil and climate, and experiment tells him which particular crop is likely to return him most profit, and he then applies all his energy and soil to the production of that crop. In South Africa, over ninety per cent. of the landholders are mixed farmers in a vague sense of the word, combining several kinds of agriculture with stock farming, and few ever give one minute's thought as to whether they could, by specialising in one particular crop, make their land produce better results. The average farm is well watered, and the undulating contour of the country makes it possible to irrigate a considerable area on which the farmer grows his wheat and oats, whilst he usually turns over a much larger area of dry lands for the production of mealies. Stock raising is carried on in conjunction with the agricultural operations, and the mealie stalks are left standing after the crop has been harvested and kept as reserve winter food for the cattle, who graze them off. By farming on this principle the average farmer makes his ground produce about one-fifth of the produce it is capable of, but as the annual yield is invariably sufficient for his needs, he is content to plod along in the same old style.

It may sound paradoxical to say that the smaller the area the larger the amount of capital required, but it is nevertheless a fact, for it is essential that the small area should be worked to its utmost producing capacity, and such intense cultivation means a large wages bill and heavy expenditure on sheds for housing stock and storing produce. If the holder of from two to three thousand morgen of ground were to realise that it would be better if half the capital he sunk in land were employed in properly improving and working the other half, he would make more money and at the same time make an opening for another man on the soil; but as such a policy means a more strenuous life, he is content to make the lesser income and lead a life of comparative ease. Mixed farming can be profitably carried on in the vicinity of a railway on a very small area, provided that the ground be worked to the best advantage and that the farmer has sufficient capital behind him to make his holding yield the fullest advantage.

The most profitable mixed farming is the combination of agriculture, dairying, and stock raising, for no product of the soil is not ultimately realised to the fullest advantage, and in a climate of so unvarying a nature as that of the High Veld of the Transvaal there is hardly any possibility of failure. A farmer possessing forty morgen of ground, one-fourth of which is irrigable and suitable for lucerne, and one-half suitable for the production of mealies and root crops under dry land cultivation, can make an annual income sufficient to support himself and family in comfort. Ten morgen under irrigation lucerne will support sixty head of cattle year in and year out, and a much larger number if the lucerne is augmented by the product of a further ten or twenty morgen of dry land cultivation. Now, the farmer who can produce sufficient fodder to keep forty well-bred milking cows in a stable can reckon on receiving about £200 per annum from the butter yield of those cows, and a similar profit from the separated milk if it be fed to pigs in conjunction with mealies and peas grown on the farm. In addition, he has a certain amount of surplus stock, fattened on the products of his cultivation, to market each year. The application of all stable manures, together with a careful rotation of crops, will keep the land in good order, though it may be necessary to use a small amount of chemical manure each year in order to ensure the maximum result. The value of the dairying industry in connection with pig raising may be gauged from the fact that, whereas it requires between five and six hundred pounds of mealies to produce the addition of one hundred pounds of flesh in pigs, the same result may be attained by less than three hundred pounds of mealies if fed in conjunction with skim milk, and the pork is of better quality.

A small farm of the nature indicated demands unremitting attention and a never-ending round of work. Cows have to be fed and milked first thing in the morning and the milk separated. The pigs and other stock have to be fed, and then the real day's work commences, for dry land farming calls for constant agitation of the surface soil, not only during the growing period, but prior to seeding, whilst the moisture is being conserved. The irrigated lucerne has to be

watered, cultivated with a specially constructed lucerne cultivator, and cut year in and year out, for it does not pay to merely water occasionally and allow the stock to feed it off. There is a never-ending cleaning of stables and stalls, watering and feeding of stock, and a second milking in the evenings, after which the day's work ceases only to be renewed as the next day breaks. However, in spite of work, the occupation is healthy and the result is a comfortable living and an assured competency.

When a man makes up his mind to go in for mixed farming, he must first find out by soil analysis if the land he proposes to settle on is capable of producing the required crops, and if not, whether the deficiencies can be supplied in the shape of chemical manures at a reasonable cost. All foodstuffs contain three leading constituents, viz., proteins or flesh-formers, carbo-hydrates or heat and energy producers, and fats and oils which produce the same effect on the animal system as the carbo-hydrates, and thus the value of all foodstuffs can be accurately gauged by the amount of these constituents they possess. It is generally admitted that cow's milk which contains 12.9 lbs. of dry matter per 100 lbs., and which contains 3.4 lbs. of assimilable protein, 4.75 lbs. of carbo-hydrates, and 3.9 lbs. of fats per 100 lbs. is an ideal food for growing stock, and as the nutritive ratio is 4.1 lbs. of carbo-hydrates and fats combined to 1 lb. of protein, all food ratios for young stock should be so balanced as to give that ratio if the maximum results are to be attained. For grown stock, however, the rations must be altered in accordance with the result desired. For instance, the ration should contain a greater proportion than cow's milk does of protein for milk cows and a less proportion of protein and a therefore greater proportion of fats and oils for cattle which are being fattened for slaughter; whilst the ration for the working animals should contain a relatively larger proportion of carbo-hydrates and fats and oils combined. A short description of these constituents may be useful to the farmer. Proteins, which are generally described as flesh-formers, always contain nitrogen, and the albuminoid variety contains sulphur as well. They are essential to animal life inasmuch as no new tissues can be formed nor wasted tissues renewed without them. Examples of protein are the white of egg, the gluten of wheat and other grains, and gelatine. In order to illustrate fully the tissue-building properties of protein one has only to refer to the fact that the recent and wonderful surgical experiments made by Dr. Russell-Bellamy, a distinguished American, have proved conclusively that the white of egg is pure protoplasm and can be directly applied to the rebuilding of the human tissues without having to go through the digestive organs of the body. By applying the membrane which lies between the shell of the egg and the contents, to which a portion of the albumen adheres, to a sterilised wound, it is found that the cells of which the albumen consists adhere to and become part of the person to whom they are applied. In this manner new flesh can be formed in the place of flesh which has withered away from disease. Such is the part played by protein in the formation of flesh. Animal life can subsist without the carbo-hydrates and the fats and oils, but without protein it must die. Thus the protein contents of any foodstuff are of vital importance. The following table of protein values, as compared to carbo-hydrates and fats and oils combined, will be of use to the farmer:—



Sheep Shed, Agricultural Show Ground, Johannesburg

Separated Cow's Milk	1 to	2
Sow's Milk	1 ,,	2
Horse Beans	1 ,,	$2\frac{1}{5}$
Peas	1 ,,	$3\frac{1}{5}$
Goat's Milk	1 ,,	$3\frac{1}{2}$
Green Lucerne	1 ,,	$3\frac{1}{2}$
Wheat Bran	1 ,,	$3\frac{3}{4}$
Ewe's Milk	1 ,,	$3\frac{3}{4}$
Lucerne Hay	1 ,,	4
Cow's Milk	1 ,,	$4\frac{1}{10}$
Mare's Milk	1 ,,	$4\frac{1}{5}$
Cabbages	1 ,,	5
Mangels	1 ,,	$5\frac{1}{5}$
Green Barley	1 ,,	$5\frac{9}{10}$
Oat Grain	1 ,,	$6\frac{1}{5}$
Wheat Grain	1 ,,	$7\frac{1}{5}$
Mixed Grass Hay	1 ,,	$7\frac{2}{5}$
Oat Hay	1 ,,	$7\frac{4}{5}$
Barley Grain	1 ,,	8
Kaffir Corn Grain	1 ,,	$8\frac{1}{7}$
Green Oats	1 ,,	$8\frac{1}{5}$
Maize Grain	1 ,,	$9\frac{1}{5}$
Maize Ensilage	1 ,,	$14\frac{2}{5}$
Maize Stover	1 ,,	20
Oat Straw	1 ,,	$33\frac{3}{4}$

The figures in this list have been compiled by the Agricultural Department.

The foregoing list shows the wide range of protein values in the various animal foods and the absolute necessity of so mixing food rations that the desired result should be attained. It will be noticed that separated cow's milk is exceedingly rich in protein, and is thus an excellent flesh former, hence its great value to the farmer in augmenting his maize crop, which supplies the deficiency of carbo-hydrates as a pig food.

The carbo-hydrates consist of starches, sugars, and celluloses. Fat and oil is the same matter in different form, fat being the solid and oil the liquid form. They are powerful heat and work producers.

In working out a ration, it must not be forgotten that all the food eaten is not digested, and therefore the digestibility of the various foods comes into the matter, and the following table of digestive values, compiled by Mr. A. Stead, will be useful :—

THE DIGESTIBLE NUTRIENTS OF FOODSTUFFS.

100 lbs. Foodstuffs.	Lbs. Dry Matter.	Contain Lbs. Digestible Nutrients.			Nutritive Ratio, or Protein to Carbo-hydrates.
		Protein.	Carbo-hydrates.	Fats.	
Cow's Milk	12·9	3·4	4·75	3·9	1 to 4 1/10
Cow's Milk (separated) ...	9·4	2·9	5·2	0·30	1 ,, 2
Goat's Milk	13 96	4·35	4·22	4·63	1 ,, 3 1/2
Ewe's Milk	20·54	6·68	4·28	8·63	1 ,, 3 3/4
Mare's Milk	9·22	1·99	5·67	1·21	1 ,, 4 1/5
Ass' Milk	9·88	1·66	6·50	1·26	1 ,, 5 3/4
Sow's Milk	15·96	7·23	3·13	4·55	1 ,, 2
Maize Grain	89·10	7·9	66·7	4 3	1 ,, 9 3/4
Kaffir Corn Grain ...	84·80	7·8	57·1	2·7	1 ,, 8 1/7
Wheat Grain	89·50	10·2	69·2	1·7	1 ,, 7 1/5
Wheat Bran	88 10	12·2	39·2	2·7	1 ,, 3 3/4
Barley Grain	89·10	8·7	65·6	1·6	1 ,, 8
Oat Grain	89·0	9·2	47·3	4·2	1 ,, 6 1/5
Peas	89·5	16 8	51·8	0·7	1 ,, 3 1/5
Horse Beans	85·7	22·4	49·3	1·2	1 ,, 2 1/3
Dried Brewers' Grains ...	91·8	15·7	36·3	5·1	1 ,, 3 1/10
Green Barley	21·0	1·9	10·2	·4	1 ,, 5 9/10
Green Oats	37·8	2·6	18·9	1·0	1 ,, 8 1/5
Green Lucerne	28·2	3·9	12·7	·5	1 ,, 3 1/2
Oat Hay	84·0	5·1	35·9	1·6	1 ,, 7 1/5
Lucerne Hay	91·6	11·0	39·6	1·2	1 ,, 4
Mixed Grass Hay ...	87·1	5·9	40·9	1·2	1 ,, 7 2/5
Prairie Grass Hay ...	—	3·5	42·6	1·4	—
*Maize Stover	59·5	1·7	32·4	0·7	1 ,, 20
Mangels	9·1	1.1	5·4	0·1	1 ,, 5 1/5
Cabbages	15·3	1·8	8·2	0·4	1 ,, 5
Maize Ensilage	20·9	0·9	11·3	0·7	1 ,, 14 2/5

* Maize Stover is dried maize stalks from which the cobs have been removed.

It will be noted that lucerne hay is an admirable food for milk producing, as the nutritive ratio is almost identical with that of milk, whilst its ash contents, which are one in twelve and a third, are greater than the ash contents of the solid matter of milk. The ash contents are of importance inasmuch as they are necessary for the formation of bone, brain, hair, etc., and thus it is essential to the health of the animal that the drain on its resources in this respect must not be greater than the supply. According to Wolff-Lehmann, a working horse requires twenty-six pounds of dry matter per day containing one part of protein to six of carbo-hydrates and fats. Now, lucerne contains a greater proportion of protein than is required, but the addition of mealies, which contain one part of protein to nine and three-quarter parts of carbo-hydrates, in the ratio of one part of mealies to twenty of lucerne hay gives nearly the exact requirements. Thus, if the ration be made up of eight and two-third pounds of mealies and seventeen and one-third pounds of lucerne hay, Wolff-Lehmann's standard is reached—and both can be produced on the average South African farm. By a careful study of food values, the farmer can so regulate the rations to his stock that the maximum amount of product and energy is secured and a minimum of waste occurs, and this is the secret of success in mixed farming in any country. All food rations should be weighed or measured in such a manner that uniformity is secured, and careful records should be kept of the results attained.

In order to show the profits which can be made by stall feeding oxen, I quote the figures of experiments made by the Free State Agricultural Department. Twelve oxen were selected, four Africanders, four Frieslands, and four Red Polls. The Frieslands and the Africanders were fed for one hundred and five days and the Red Polls for eighty-three days. The Red Polls were young and in fair condition when they started feeding. The ration was thirty pounds cattle cabbage, twenty pounds maize ensilage, and two pounds mealie meal per head. The mealie meal was gradually increased to five pounds per head, and for the last month thirty pounds of mangels were fed instead of cabbages. The gross result was a net gain of two thousand three hundred and two pounds live weight, at a cost of £27 6s. 0d. for food. This means that the value of gain in weight is more than the cost of feed, and at the same time the saving in sending the grain and other products to market on the hoof as against sending them direct is enormous. It was admitted that the ration might have been improved. Before leaving the subject, it is as well to state that the Friesland and Africanders were old trek oxen, whereas the Red Polls were young, and had the gains of the older oxen been as great as was the case with the younger ones, the result would have been even better, for the four Red Polls showed a gain of nine hundred and thirty-seven pounds at a cost of £7 12s. 8d.

With such a fine and expanding market for all classes of produce and livestock as is offered by the Rand, there is every inducement to the man with a knowledge of the business and sufficient capital to go on the land, for the danger of over-production for local needs is hardly likely to loom up for many years, and even then, when the vast areas of South Africa are made to produce more than sufficient to supply local requirements, it must not be forgotten that South Africa is many miles nearer to the European markets than Australia and New Zealand, both of which countries are growing richer year by year on their export trade. Mixed farming, scientifically carried out, enables the farmer to get a maximum return from his land, and though the mining industry of the Transvaal sinks all other industries into insignificance to-day, it must not be forgotten that some day, when the metal production is on the wane, the farming industry will take its proper place as the basis of national prosperity, and the man who is settled on a fully improved and intensely cultivated area will be a person to be envied.



Grain Mills, Pretoria. The Pretoria Milling Company.

Stock Farming in a Typical Transvaal District

By A SPECIAL CORRESPONDENT

LYDENBURG is a large district, but a goodly portion of it—roughly speaking, all that east of the newly constructed Selati Railway—is a Government game reserve, and consequently not available for farming operations. If it were given over, it would be principally used by trek Boers for wintering cattle and sheep, but it is eminently suitable for cattle farming, and, no doubt, in the course of time many men would make a permanent home there, going in for this class of industry combined with attention to tobacco and cotton raising. The remainder of the district comprises varieties of High, Middle, Bush, and Low Veld, all good and representative of their class. It is for the most part well watered, and those parts which have no perennial streams could be supplied by constructing dams, as a sufficient annual rainfall is always obtained even in the driest Bush Veld.

Making Hay for Stock.

The district is one of great promise and possibilities, and the few drawbacks there are in the way of successful stock farming are not by any means unsurmountable, but could be easily overcome with a comparatively small outlay of individual capital and energy. Taking the district all through, the sleek appearance of the cattle in the summer is evidence that the natural veld grasses are full of nourishment, and these same grasses can and have been in some instances turned into excellent hay much appreciated by stock and capable of helping them through the winter, or, if fed in sufficient quantities, of keeping them even in good condition. Hay-making is but little understood here, and unfortunately so, otherwise, if taken advantage of, it would put money into the farmer's pocket by saving his annual winterly loss from deaths and depreciation in condition. In my opinion, it is nothing short of criminal to make no provision for winter feeding, but to let cattle suffer when nature has given an abundance and to spare if we only gather it. Man lays up a store of grain and roots for himself, but does not use his natural foresight on behalf of stock over whose destiny he has taken to himself full control.

Artificial Feeding.

In addition to natural veld grasses, good assistance can be obtained from paspalum, lucerne, roots, etc., all of which grow and do well on the High and Middle Veld here, and should prove a lucrative investment, being much appreciated by all stock. In the few instances I have seen where paspalum has been sown, it gives promise of remaining a permanent pasture and choking all other grasses. That is, of course, if sown in suitable positions.

Tree-Planting for Stock Shelter.

Too little attention up to date has been devoted to tree-planting. Stock need trees both in summer and winter for shade and shelter. What observer but has noticed the natural inclination of all animals to seek the shade of trees from the broiling summer noonday sun, where they can lie in the cool and cud the food which has been gathered and stored in the rumen during the cooler hours of the morning. Again, trees maintain a more equable temperature both in summer and winter. Where paddocks are ringed by high, good-foliaged trees, the grass remains greener and more luxuriant and stock do better in consequence of this and the protection afforded from summer and winter elements. Winter cold is not too cold unless accentuated by a piercing wind, and winter can be staved off longer and spring brought on earlier by a judicious planting of protective trees. Nature has provided us with trees, which she intends to be used for these purposes if we only read her signs aright. A countryman, as compared with a townsman, is credited with greater powers of observation of the small details which often make all the difference. The fault apparently lies in an undercurrent of apathy which prevents him applying his knowledge to the best advantage ; while, on the other hand, a townsman, his business instincts brought to the highest pitch of perfection by constant and keen competition in the struggle for existence and a little over, is quick to press an advantageous point home and reap the benefit of his good judgment.

Fencing.

If there is one thing needed above all others to make stock farming safe it is fencing. Stock farming in an unfenced district is the same as grain farming in a place where the rainfall or irrigable water supply is subject to uncertain variations. It is subject to large risks and is unsound from the bottom, failing absolutely in principle. Contagious diseases will arise—like the poor, they are always with us—and their spread can only be prevented in most cases by either a wide spread of unoccupied intervening country or a wire fence. Of the two, the latter has proved in this country undoubtedly the most effective. Given a well-fenced, and if possible a paddocked, farm, a man has got his stock under absolute control, and is as good as insured against serious loss from almost all devastating contagious diseases.

Dipping.

Too little advantage has been taken up to date of the discoveries made by well-known and eminent South African veterinary surgeons that most of the losses amongst stock are of the malarial type, and caused by insect innoculation. In some few the transmitting cause has not been definitely proven, but there is practically a sufficient amount of negative evidence to convict the suspects. Examples of tick-borne diseases are as follows: Gallsickness, redwater, East Coast fever of cattle, heartwater of cattle and sheep; while those suspected to be conveyed by the mosquito are blue tongue of sheep and horse sickness of horses and mules. These diseases are the most serious in South Africa at the present moment and can all be prevented. Blue tongue and horse sickness by a preventive innoculation and the others by properly conducted dipping operations to destroy entirely or keep within reasonable bounds the tick pest.

High Veld.

The High Veld portions of the district are healthy for all sorts of stock, and a properly run establishment could maintain its animals in the same excellence of condition throughout the year. I have seen roots growing there equalling those grown in Europe, so abundance and variety of feed can always be obtained with an effort. The High Veld is eminently suitable for merino sheep, cattle, and horses, and these three classes are being profitably farmed there at present, thought in most instances in the same old rough-and-ready style preferred by the Voortrekkers.

I do not see any reason why the warmer portions of this district should not be made as healthy as the High Veld. That they are not so at present we know, but we also know the reasons why, and that they are apparently preventible reasons. The time is bound to come, however, when the Bushveld farms will be all permanently occupied, and then these problems will be tackled and overcome. At present sheep and Angora goats cannot be farmed in the Middle, Low, and Bush Veld because of heartwater. Cattle, also, in the summer suffer from the same complaint, as well as redwater and gallsickness. Now, all these diseases can be absolutely eradicated by systematic dipping to destroy the conveyor, viz., the tick. Keeping this in view, I do not see why, in the future, when a progressive farming community has learned to take advantage of the discoveries of science, stock farming of all sorts in the warmer veld should not be as payable and safe a proposition as on the High Veld. It is not the higher temperature of the Low Veld which causes animal diseases, but the fact that the temperature is exceptionally favourable to the existence and rapid multiplication of numerous forms of insect life, including those parasitic blood suckers feeding on other animals and man, and which, in many instances, act as the transmitters of malarial diseases which, without their active interference, would die a natural death from lack of opportunity to gain access to the body of a new victim.

Horses.

Horse breeding has been confined to the High Veld, but with the advent of Dr. Theiler's preventive innoculation against horse sickness I see no reason why a lucrative business should not be made of it by Low Veld farmers. There is no doubt but that a Bush Veld-bred horse is preferred by farmers for hardiness and reliability, and with good reason, too, so far as I have seen.

Pigs.

Pigs have been much neglected, so far as making a paying industry out of their breeding, rearing, and fattening is concerned. The reason for this lack of attention must surely be that the business is not properly understood. A lot more people would eat pork if they were certain of it being free from measles. This would increase the demand and so keep up the price. Here we have no contagious pig disease to handicap us, but measles is all too prevalent amongst those foraging loose on the veld. This is an indication that the free running farming of unimproved breeds should be dropped, and instead should be adopted a quick-growing, early-maturing pig which it will pay to breed, rear, and fatten in camps (which can, nevertheless, be of a fair roaming size) slightly away from the homestead and any chance of measles infection.

When one realises the significance of the fact that South African farmers send mealies to England, that they are there turned into bacon and hams, and returned as such here, does it not seem a certainty that business opportunities are being lost, that there is a very big leakage in farm profits which should remain in South Africa? If it pays to do this, then surely feeding pigs on the spot with produce grown on the spot, thereby saving all this extra cost of transport, should pay handsomely, otherwise my scheme of reckoning is lacking in some big detail of expense I have not taken into account.

In conclusion. Stock here seem to always sell well, and there is always a demand for acclimatised breeding cattle, which demand, as time goes on and risks from contagious and other diseases lessen owing to proper private and Government precautions taken against them, has every prospect of increasing. The farming community has been kept back here by their unwillingness to risk their capital in cattle with an ever-present dread of East Coast fever wiping them out. To-day things are different. The present prices obtained are an indication of re-established confidence in stock industry. Never have cattle sold better or the demand been greater, and on all sides there seems to be a gratifying tendency to go in more for improved breeds, or rather crossbreeds of a milk or beef strain. There is no doubt but that stock farming, if properly run, yields handsome profits, and the strong policy the Goverment has maintained towards the eradication of pests which have been strangling it has been much appreciated by every thinking owner, and it has turned a gambling concern into a steady and settled profitable industry, which can now, at last, we hope, be rightly termed "the backbone of the country." But without this strong policy this term would never have been earned, and we should have remained a struggling community living on the mining industry and waiting for something to turn up.



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The Influence of Johannesburg on Agriculture in the Transvaal

By F. T. NICHOLSON,

Secretary of the Transvaal Agricultural Union From *Johannesburg To-day*

TWENTY-EIGHT years ago it was my lot to journey from Worcester, in the Cape Colony, to Pretoria, the seat of Government in the Transvaal Republic. The journey occupied something like ten days and nights of almost incessant travelling by mail-coach, our longest halts being for three hours in Kimberley and two hours in Potchefstroom. The former town was the scene of a strike among the natives, something similar to that which took place at the Premier Diamond Mine, near Pretoria. Potchefstroom, the capital of the country, consisted almost entirely of one long, willow-shaded street, supplied with an abundance of water. The journey had been a most wearisome one, and the greenery of Potchefstroom contrasted very agreeably with some of the stretches of semi-arid country through which we had travelled. I was fresh from the fertile plains of the County of Cheshire, where it had been my lot to be intimately associated with farming life as it then existed in that part of England. From Potchefstroom to Pretoria the road led through that part of the country which has since become famous as the centre of a wonderful gold-mining industry. Perhaps my early training may have served to make me more than usually observant in respect of the farming possibilities of the country to which I had come, and caused me to note the possibilities which, even then, could be detected by anyone who had an eye to the value of land. Be that as it may, I have never ceased to believe in the agricultural future of the Transvaal, and, as the years go by, I am more than ever convinced that we have not begun to realise the potentialities which are contained in the fruitful soil of the Transvaal. I know that undreamed of wealth has been excavated from the mines of the Rand, and that there are still vast stores of ore, which will continue to yield enormous wealth for many years to come, but I hope to be forgiven when I say that this wealth is not to be compared with that which will yet be taken from the soil of the Transvaal by the willing hands and the trained experience of her farming population. It would be impossible to say to what extent the farmers of the Transvaal, nay, of the whole of South Africa, are indebted to the gold-mining industry for the development of agriculture ; but I venture to say that, in no other country in the world can we find a population of farmers who are so richly endowed with possibilities as are those of the Transvaal, and also that these possibilities are almost entirely owing to the brains and to the capital of those who are responsible for the developing of our great mining industry. It is to be greatly regretted that a better use is not being made of those opportunities, and that we are labouring under the disgrace of having to import millions of pounds worth of farm produce into a country where, if every farmer were expending his energies to the best of his ability, no such importation would be necessary. We should rather be supplying all our local needs, and should be exporting our surplus products to other lands at remunerative prices. Still, no one who has lived for the last twenty-five years in the Transvaal can fail to see that we are on the up-grade. It may interest those who read of Johannesburg to-day to learn something of the conditions which prevailed in the Transvaal some thirty years ago, and to compare those conditions with the circumstances of these times of National Union. Of course, there was then no Johannesburg, and the veld upon which that town now stands was regarded as being only of an average quality, possessing no features likely to attract an increased population of farmers. Would that we had known the hidden wealth which lay beneath the somewhat unkindly surface. The only market of any account at all in the Transvaal was that of Pretoria. The pushing farmer went further afield, and took his produce to distant Kimberley, where prices were more tempting. Rustenburgers used to bring a load of firewood a distance of sixty-five miles to realise the magnificent price of fifteen shillings therefor. The innocent rooster, who found his way into the pot of the boarding-house keeper, never cost more than a shilling, if the purchaser knew his way about. Eggs were sixpence a dozen, with quite as good a guarantee as to freshness as is given in these more advanced times. Oxen changed hands at from thirty shillings to two pounds a piece, and farmers from the neighbourhood of the present Johannesburg trekked to the bushveld as the winter approached with as many as two thousand head of cattle each. There was practically only one kind of plough in the country, the old "seventy-five," and modern agricultural implements were almost undreamed of. Such ploughing as was done was a mere scratching of the surface soil on the richest part of the farm. The veld teemed with game, and the farmer of those days managed to exist with a fair amount of what he considered to be comfort and a very slight expenditure of manual labour. Then Johannesburg arose, and there followed the development which has characterised the last twenty-five years. The opening of the gold fields presented opportunities to the farmers such as had never previously entered within the somewhat circumscribed range of their vision. Many realised large sums of money for options on their farms, while others suddenly became rich men owing to the

sale of their properties. I well remember one such man. He was in office under the Republican Government, and his salary depended upon the amount of business which passed through his hands. He met me one day, and told me of the hardships of his lot, and, pulling out a pocket-book in which he had recorded his earnings for the month of March, he showed me figures which satisfied me that the total was £4 3s. 6d. That man sold a gold farm for £100,000 and spent the remainder



Scenes at the Witwatersrand Agricultural Society's Show

of his days in prosperity. The ordinary farmer, who had no gold farm to sell, also found his conditions greatly improved, and, when he had anything to sell, secured remarkable prices for his produce. I have seen butter sold at twenty shillings a pound, and cauliflowers at seventeen shilling and sixpence apiece in those early days of the mining industry. Then followed settled markets, where the farmer found himself unable to meet the rapidly increasing demand for his produce, and this led to a stirring of the dry bones and the slow development of farming activities. The story of the war, and the establishment of the Agricultural Department, under the prescient Government of those days, is well known to everyone, but we fail, sometimes, to give credit where it is due, and are disposed to treat with disdain the officials of that Department, without whose aid we could not have been where we are to-day. We are, however, only just emerging from the old conditions, and it may be well to devote a little space to the setting out of some of the features which go to show that we may develop to an almost unlimited extent. What we need is capital and well-directed energy. Nature has provided the raw material out of which we may, by the exercise of intelligent labour, build up a permanently prosperous industry. I well remember when I made my first importation of cattle from England, how I was greeted with the friendly chaff of my Boer friends, and asked

what such animals were good for. To-day, those same Boers are the first to come round and ask my advice as to the class of imported sire which they should use to improve that stock which they used to tell me could never be improved upon. The days when a few sacks of scabby wool represented the sole output of many farmers, and when it was bartered for such household requisites as were supposed to represent its commercial value, are gone for ever, and we have a large number of intelligent sheep farmers, who are realising excellent prices for their annually improving clip, while they are importing new and improved blood from Australia and elsewhere. My earliest recollection of an attempt to import foreign cattle, by a Transvaal farmer, was the introduction of Frieslands, chiefly for dairy purposes. To-day we are in possession of excellent animals of almost every known breed, and valuable herds are being established throughout the country. We are also awaking to the fact that profitable trade may be done in respect of military remounts, and it is likely that, at no distant date, the Transvaal remount, owing to his hardy qualities, and his well-known powers of endurance, will rank highly in the estimation of the military authorities. Though few in numbers, we have poultry which would compare very favourably with that of any country in the world, and we are within reach of the day when we shall cease to import eggs and poultry to the annual value of £143,000. This does not mean that we are at the limit of our market, but that, when we are in a position to do so, we can double our sales, at prices such as do not prevail in any other country in the world. Even the humble pig is becoming popular with those who know his value, and a prominent M.L.A., of the Unionist party, told me, only a few days ago, that, two years ago, he bought a pair of pedigree Berkshires, and that they had in the meantime increased to eighty-four. We have a climate which is admirably suited to the development of animal life, and the stock farmer is bound to make large profits for many years to come under the ordinary conditions which prevail. So much for our pastoral industries. What is the outlook from the point of view of the agriculturist? We have, in the past few years, introduced many new varieties of crops, and some of them, such as lucerne, have come to stay. This one fodder plant makes the farming of ostriches possible, and may add largely to our national wealth. New varieties of wheat, among which will be those which are rust-proof, will revolutionise our farming operations, and will help us to bring to an end the importation of our main food supply from other countries no more favourably situated than we are. Grasses from other lands are being introduced, and already we have varieties which promise to go a long way in the direction of providing winter food for our stock. We are planting trees by millions, and fortunes await the men who will plant large areas with varieties of trees suitable for mining purposes and railway sleepers. Horticulture has also a great future before it, and the labours of the Government Horticulturist have served to prove that we need not be behind any other country in producing fruit of a quality which will meet with a ready market both here and elsewhere. It is a well-established fact that we can produce wine of an excellent quality, and in this direction alone there is a great future before us. We are possessed of that red loamy soil, rich in iron, which is so necessary to the growing of grapes. Nor need we confine ourselves to the cultivation of the ordinary European fruits; we have large areas where tropical and sub-tropical fruits can be raised with a considerable margin of profit. To the question, "Watchman, what of the night?" we may confidently reply, "The morning breaketh, and the day is at hand." What we need is capital, intelligently employed, and there are many signs that this will be forthcoming. Many of our financial men have already invested large sums of money in farms, and are rendering a good account of themselves. Outside of this we need to encourage the settlement of men of moderate means upon the land, men who will not be work-shy, but will be content to toil for a satisfactory competency. To-day we have an area of some thirty-three million morgen of land, or about seventy million acres, the larger proportion of which is lying useless. Much of this can be brought under cultivation and would readily respond to modern methods. Some ten million morgen, or twenty-one million acres, are the property of the Government, and are awaiting full development. We have a rainfall which has averaged during the last four years thirty-two inches throughout the Transvaal and about twenty-five inches in the high veld districts, where our stock-raising must be carried on. Land can be purchased at from four shillings to thirty shillings an acre, and opportunities frequently occur of renting land at exceptionally low rates. Over large areas frost is unknown, and even on the higher lands the cold of winter is only such as to give a healthy zest to life. With the proper conservation of water in dams, and the exploiting of the large underground supplies which are available in almost every part of the country, millions of acres could be brought under cultivation, and would yield crops such as only virgin soil can produce. Nor have we any lack of assistance from a sympathetic Government, as will be seen from the following list of divisions in the Department of Agriculture, manned, as they are, with some of the most capable of modern experts: Agricultural School at Potchefstroom, Agricultural College in prospect at Pretoria, botanical, branding, bacteriological, chemical, co-operative, dairying, dry land farming, entomological, experimental farm, editorial, forestry, fencing, horticultural, ostrich, poultry, statistical, tobacco, veterinary, etc. Surely there is abundant cause for congratulating ourselves on the fact that we are so well served in respect of the staff engaged in the various divisions above enumerated. At the risk of wearying readers, I venture to add a list of the average prices obtained on the Johannesburg market during the year, as these will serve to indicate the chances of the profitable sale of some of the most common products of our farms. Apples, 9s. 6d. per hundred; bran, 8s. 3d. per 100 lbs.; barley, 13s. 3d. per bag; green barley, 11s. 3d. per hundred bundles; ducks, 3s each; eggs, 3s. per dozen; oathay, 5s. 6d. per 100 lbs.; fowls, 3s. each; geese, 5s. 9d. each; Kaffir corn, 10s. 9d. per bag; lucerne (green), 10s. 9d. per hundred bundles; baled lucerne, 5s. 3d. per 100 lbs.; lemons, 7s. per hundred; oranges, 8s. 4d. per hundred; maize (white), 12s. per bag of 200 lbs.; maize (yellow), 11s. 6d. per bag; naartjes, 6s. per hundred; onions, 11s. 6d. per bag of 120 lbs.; potatoes, 15s. 6d. per bag of 150 lbs.; wheat, 20s. per bag; pigs (live weight), 4d. per lb. I venture to say that these are prices which



"Green House," Onderstepoort, Experimental Mosquito Station

would make the mouths of farmers in other countries water with anticipation, and also that, in most instances, these prices would have been considerably enhanced had proper methods been adopted so as to place the produce upon the market in the best possible manner. Under Union, it is likely that there will be no deterioration in respect of the efficiency of the staff of the Agricultural Department, nor is there likely to be any lack of sympathetic consideration at the hands of the Minister of Agriculture. General Botha has always manifested the keenest interest in the development of our agricultural resources, and we are not likely to fall short of the standard now prevailing. Enough has been said to show that the subject of agriculture is not out of place in a work dealing with Johannesburg to-day, and no ill-effects can follow from a frank recognition of the fact that the condition of affairs which has been roughly sketched in the foregoing lines, and the prospects which lie before us in the future, are all largely owing to the fact that the wealth of Johannesburg has served to attract to the Transvaal the men and the capital which are responsible for our progress as farmers. As I have already said, there is an urgent need that more capital should be introduced into the farming industry of the country, and there is also room for men of intelligence who will devote themselves to the exploiting of the agricultural wealth which lies ready to the hand of the diligent.

Cotton Growing in Lydenburg

Showing How Cotton Can be Grown as a Commercial Venture in the Low Country of the Lydenburg District

By Lieut.-Colonel F. van STEINAECKER

IT is not to be denied that the production of raw cotton in the United States of America has very nearly reached its limit. The acquisition by the United States of the Philippines and other colonies in the Pacific, where cotton goods are worn almost to the exclusion of all others, has given an enormous impetus to the cotton-manufacturing industry in the States. Cotton mills have consequently sprung up everywhere. It is, therefore, a natural consequence that the export from the States of raw cotton cannot keep pace with the demand for that material, especially in England. The efforts made by the British Cotton Growers' Association, Liverpool, to introduce cotton growing in the British Colonies and Dependencies have, up to the present, had good results. But all the enterprises set on foot with the help of that association are still in their childhood. As far as South Africa is concerned, some have been sadly mismanaged, and therefore have turned out failures. In one or two instances, these beginnings of growing cotton were meant to be failures. Cotton, as is well known, requires cheap labour besides suitable climatical and soil conditions. A distinct wet and dry season is a conditional sine qua non. The climatical conditions of our High Veld are unsuitable for the cotton plant. But in the lower regions and in the so-called Bush Veld cotton will prosper and do well. It is with cotton as it is with other things. A successful cotton grower must have knowledge and experience.

Low Country in the Lydenburg District.

Soil.—Though there is no Canadian Wheat-Belt soil in that part of the country, with the exception of a large strip of land in the Game Reserve, the soil generally is quite suitable for the cotton plant. There are the red clay soils, more or less heavy, and the lighter sandy soils, which are preferable. One must not lose sight of the fact—which is only too often forgotten—that in new lands the tiller thereof has to train his lands for the purpose for which he wants it. This, more than anything else, requires knowledge, and otherwise good ground has often been spoiled by unsuitable treatment. The cotton plant, being a tap-root plant, naturally requires deep cultivation. In a land where the clearing of scrub and bush is the beginning of any cultivation, and where roots, etc., are to be reckoned with, the heaviest implements are just heavy enough to cope with the work of breaking the ground.

I will here give a piece of advice to beginners, which they will find useful. In breaking ground here in the Low Country never use a double-furrow plough. This implement is all right where no tree-stumps, stones, etc., are to be found. A single plough can avoid obstacles. A double cannot; and breakage is the inevitable result. Another item of importance is: never harrow a newly broken ground with a tooth-harrow, but with a full-disc, and not across.

The climatical conditions are very favourable. The rainfall within the last six years has never been below thirty inches. The deep cultivation of the ground acts as a reservoir for moisture. It has been found by experience that the sowing of cotton should be finished before January 1st. The late seasons of the last few years have had a bad effect on the productiveness of the plant. The cotton in late seasons or late rains tends to make too much wood, and it seems that the strength of the plant exhausts itself in that process rather to the detriment of its productiveness.

Early sown cotton can be picked and marketed in Liverpool before the American crop arrives. This means that at the end of the season at Home the reserves of the spinners are at a low ebb, and South African cotton can be marketed at better prices than would perhaps be otherwise the case.

Labour.

If anywhere in the Union of South Africa this question is easy of solution it is in this district. Cheap labour is one of the essentials of the cotton industry. Here there is ample labour at hand, and the work is liked by the natives. If the native dislikes anything more than other things connected with work, it is constant supervision, the pushing and driving whilst at work. All this is occasionally necessary where agricultural work is concerned, for the simple reason that our agricultural labourers are by no means cheap. With cotton this is different, especially with regard to picking. This is done and paid for by weight, and supervision is

only necessary as regards picking clean. I have had an experience unique in my twenty-five years of work in South Africa—that is, that women came to me looking for both hoeing and picking work who lived many miles away from my place.

Cost of Production.

The return of seed-cotton per acre can be put down at a low estimate of three-quarters of a bale of lint (or 1,125 lbs. of seed-cotton). In cultivated land the cost per acre (wages only) is approximately as under :—Two ploughings at 4s., 8s.; three harrowings (four acres per day), 1s. 6d.; three horse-hoeings (three acres per day), 2s.; one hand-hoeing and thinning, 5s.; sowing (eight to ten acres per day), 3d.; picking 1,125 lbs (2s. 6d. per 100 lbs.), £1 8s. 6d.—total, £2 5s. 3d. per acre. With the addition of mealies for food, it will be clear that an acre of cotton can be worked at a cost of about fifty shillings. The cost of baling and ginning depends entirely on whether the grower possesses his own plant or whether he has to send his cotton to a mill. The shipment of seed-cotton (cotton with the seed not extracted) is out of question. Generally speaking, one bale of lint of 500 lbs. weight is produced from 1,500 lbs. of seed-cotton. As at the present moment there is no market for cotton seed, the shipping of unginned cotton would entail transport costs for two-thirds of valueless bulk. Unginned cotton cannot be kept any length of time as the oily seed discolours the fibre, and consequently lowers the value of the lint. It has also been found that such cotton is weaker in the fibre than others of originally equal quality which has been ginned soon after picking. It can be safely surmised that the baling and ginning cost about £1 per bale. Transport, etc., will cost another thirty shillings per bale. The total cost of cotton growing up to the moment of sale is, therefore : Cost of production, £2 10s. (three-quarters of a bale of lint per acre); ginning, baling, transport, etc., £1 18s. per acre. To allow a fair margin, it will be safe to put down cost of growing, ginning, baling, and shipping at £5 per acre.

Taking three-quarters of a bale as the yield per acre, and taking the present market price of the average upland variety at the low figure of 6½d. per lb., the return will be slightly over £10, or a profit of £5 per acre. This seems to be a very poor return ; but I beg to point out that all figures in connection with the costs have been put down at a very high rate, while the figures of return are very low. My last shipment of cotton grown in the Low Country of the Lydenburg district fetched not 6.5d., but 7.86d., and prices have an upward tendency. In speaking of the very ticklish question of cost of production, I have made it a rule never to undervalue its items, rather to make the figures as high as reasonably possible. I have seen many estimates of this kind put together by supposed-to-be competent men, but I have invariably found that these figures were wrong. Local conditions vary so much that it is almost impossible to make a correct estimate of costs of working. It seems to me that to encourage this cotton industry, it is best to see that those who do engage in it do not get disappointed.

A man who finds at the end of the year that his calculations based on published estimates are wrong, to his detriment, will more often than not give up cotton growing as unprofitable. The man who finds that his returns are better than he expected will go on growing cotton. There seems to be not the slightest doubt that this cotton industry will work its way into the low-lying districts of the Transvaal, in spite of the fact that in South Africa nobody seems to have any time or money to spare for anything but mining, however problematical the proposition may be. This is much to be regretted, as it retards the progress of the country. Cotton will be grown in the Low Countries at a time when the now flourishing mines on the Rand will be to the future generations what Zimbabwe is to the present.

Unfortunately, the Low Country has a bad reputation both with the public and the Government. Of the first, either thoughtless people or those who have an axe to grind have talked and often written about the Low Country as if it was fit only for wild animals. Both climate and soil, as well as labour conditions, are as favourable to cotton growing as anywhere in the Union. The most unfortunate result of the bad reputation of these parts has been the inauguration of the Game Reserve. Though I am as much in favour of the preservation of the species of big game as any faddist may be, but I am of opinion that in countries like the Transvaal the preservation of game must not be carried to the extreme. If it becomes a question whether the game or the progress represented by the ploughshare is to win the day, the game has to go. The little Transvaal has more than ten times the area of game reserves than the United States of America. A railway now running through the middle of this low country facilitiates the production of cotton and other sub-tropical plants. An established cotton industry would be a great step forward and would tend to the enrichment of both private individual and the Government. It would tend to the elebation of the natives living in these districts, and be beneficial to the whole country.

I have over seven years' experience of cotton experimenting and growing in these parts, and have come to the conclusion that cotton growing as a commercial venture can be carried on in this district with advantage and profit.

The items tending to success are too numerous to mention in an article like this. I am prepared to give information to the best of my ability to anyone who wishes it. I will, however, mention a few essential hints. Careful preparation of land combined with deep cultivation ; early sowing ; keeping the fields clean and not allowing the soil to bake on the surface. As in any other branch of the exertion of human energy, experience and knowledge are factors not to be set aside or overlooked.



Agricultural Show Ground, Johannesburg



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The Automobile World

Specially Contributed

RECOGNISING the fact that South Africa has furnished much that is marvellous in industrial enterprise in the past, it is not altogether surprising that the motor trade should provide yet another instance of the striking development which has entitled this country to the improtant position it occupies in the van of the world's progress. The demand for automobiles, it may be mentioned at the outset, was never so accentuated as it is to-day, and in support of this statement, were the manufacturer of the high-grade machine, in particular, approached for his opinion in regard to the best outlet for sales, he would unhesitatingly yield South Africa the premier place.

The accusation, so long hurled at the British producer, of neglect in the matter of the South African automobile market was by no means an idle one, and its insistence has been instrumental in largely removing the ignorant notions which existed as to the extent and importance of the field of operation, which in turn prompted the idea, until quite recently fostered, that the market was one of secondary importance. It is gratifying, however, that the true position has been grasped by the leading manufacturers, who are now making a special study of the requirements which the peculiar conditions of the country exact.

Without a seeming incursion to the field of platitudes, it may be stated that Johannesburg, the commercial capital of the Union, possesses more cars in point of population than any of the other important world centres, the greater number by far being engaged in the interests of the various mining pursuits. A little over a decade ago the automobile was introduced to this country, and even at that early date its latent possibilities were not overlooked by the leaders of the mining industry, and the favour with which it was received, despite the very imperfect road system of that period, which might be expected to militate strongly against its popularity, was found in striking contrast to the attitude adopted by many in other parts of the world, who viewed the motor-car askance, and heaped upon it undeserving obloquy.

The transition of the car has been indeed phenomenal, and the efficiency attained to in the modern production is all the more remarkable having respect to the many measures introduced calculated to impede its progress in the shape of restrictions of a legal nature, for example, the by-law dictating that all mechanically-propelled road vehicles should be preceded by a man with a red flag, and diverse opposition from the uninitiated of that time. The accompanying illustrations are interesting, and show at a glance the wonderful development which has taken place in the industry even in the short space of ten years.

The photographs of the cars reproduced are both of the Arrol-Johnston type—a name familiar to all South African motorists—of the years 1902 and 1912 respectively. The primitive machine, fitted with dogcart body, is still in regular use, a fact bearing eloquent testimony to the soundness of the manufacturing methods of the famous Scotch firm of motor-car builders to which it owes its origin. It may be of interest to remark that the 1913 programme of this concern includes the turning out of one thousand five hundred finished cars. The 1912 machine of this name, appearing in the illustration, competed in the recent Grand Prix.

As this article is written in the main to show the relative position the car occupies in regard to the mining industry, a brief reference to a few of the more prominent machines in general use with the various mining corporations may be permitted, and as this publication has no immediate trade interests to serve, it can be accepted that nothing in the nature of an advertisement is intended. Were a return of the different cars available, however, it would probably be found that, from the numerical standpoint, the 12 h.p. Talbot car would be placed an easy first, and therefore may be accorded primary mention here. This well-known car has certainly much to recommend it in point of power, grace of design, ease of movement, and silence, and the secret of its immense popularity—which has been altogether unique for several years past—lies in the fact that it satisfactorily fulfils colonial requirements—a condition of paramount importance to which



A Car on a Colonial Main Road.



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most of the present-day makes conform—and is marketed at a moderate figure.

In the hundred or more different types of cars in daily use in Johannesburg are included many excellent machines, from the prosaic runabout to the lordly landaulette, at prices suited to all purchasers. In the



A Motor Accident

former two-seater category reference may be made to a few favourites: The 12 h.p. Adler, 10-12 h.p. Austin, 16 h.p. Buick, 12 h.p. Delage, 15 h.p. Overland, 8-10 h.p. Phœnix, 8 h.p. Renault, 12 h.p. Rover, and 10-12 h.p. Vulcan. These and others, of which space will not afford mention, in the small class embody many successful features, and have rendered valuable service to the mining industry in the past, being specially constructed to negotiate all hills of reasonable grade, in addition to furnishing that measure of speed which has contributed so much to the popularity of the roadster for Reef duties. A wide choice in regard to the requirements of the leading industry, and the general purchasing public, is also offered in both the medium and larger-class machines, but for the purposes of this article no classification in regard to price or quality is attempted. The afore-mentioned small-pattern cars, it is hardly necessary to remark, are of the same high-grade standard of excellence as the higher-powered and equally popular models in this country. Other makes in general use, affording a much greater accommodation, invariably built on lines of the touring car, number such well-known types as the Argyll, Armstrong-Whitworth, Belsize, Daimler, Darracq (the pioneer of South African traction), Ford, Humber, Maxwell, Metallurgique, Mitchell, Napier, Standard, Star, Sunbeam, Vauxhall, and Wolseley. These cars are made in several separate models, seating from four to seven persons, with a choice of two or more wheel-bases, and are designed with a view to withstand South African climatic and other conditions, in the majority of cases being fitted with wire detachable wheels, which is becoming a popular feature of most cars for colonial use owing to the undoubted strain-resisting qualities they embrace. Most of the machines favoured by the overseas motorist can be obtained from the local representatives at the manufacturers' catalogued prices, plus importation charges, a fact which it is evident is not sufficiently appreciated, else the endeavour to import automobiles direct would not be countenanced. Arrangements, however, as a rule, exist between the agent and manufacturer of the high-grade machine whereby the interests of the representative is protected against any questionable dealing affecting the sales of cars, and many makers to-day positively refuse to sell to the resident of a district, or country as the case may be, where an agent is established, without the express permission of the latter. From many points of view it is distinctly in the interests of the prospective colonial purchaser that the sale should be effected through the appointed representative, who is naturally best informed as to the actual requirements, and advises the manufacturer accordingly. Couple with this the considerations that the agent carries stocks of spare parts, and is quite conversant with the many technicalities with which the purchaser may be totally unfamiliar, and which, in the absence of such knowledge, the general efficiency of a car may be adversely influenced, and the force of the argument is at once apparent.

The motor-car is destined to play an important part in the future development of South Africa, in the rôle of civilising agent, and even now its value in linking up with the various commercial centres those parts so long detached, where the railway facilities obtaining are of the limited order, cannot be overestimated. The rapid transit afforded by the automobile is being recognised at its true worth more and more daily by the commercial and industrial communities, and when in time the enormous natural wealth of the sub-continent is being exploited, it will be found that the advance in this direction will be largely influenced by the motor-car. A considerable handicap, however, attaches to the car as a developing factor by reason of the imperfect nature of much of the existing road system of the country, and although large sums have been spent on construction and other work, much remains to be accomplished. This is apparent when one considers that outside the towns proper, with a few notable exceptions, in the past no serious effort at roadmaking has been attempted, not that its value was underrated, but the needs of the populated parts taxed the resources of the various bodies responsible, from several standpoints, to such an extent that the sparsely-inhabited districts were perforce neglected. Much influence of late has been brought to bear on the Government from motorist quarters in regard to improved road communication, resulting in practical recognition gratifying to record. The Rand-coast road, it is understood, has also met with the approval of the Legislature, and when its completion is effected, the promoters may feel assured that this great route, which will provide such rapid travelling facilities, will contribute in no small measure to the natural development of South Africa.

At enormous cost, it may be remarked in passing, the Johannesburg Municipality has constructed a network of macadamised roadways of which any European city might well be proud, many miles of new roads being added yearly, and this achievement is all the more remarkable having respect to the fact that twenty years ago the parts now occupied by these modern highways were virgin veld interspersed, in the usual way, with many formidable patches of outcrop reef, etc., while in other places the courses where the rushing waters receded in the wake of the torrential downpours proved frequent obstruction to the work of roadmaking. Those, therefore, who are inclined lightly to criticise the work accomplished will do well to ponder on the immense difficulties which beset road construction in the early days. The problem of keeping down the dust on the roads, when made, is almost as important as their construction and maintenance. The most effective,



Another car in trouble

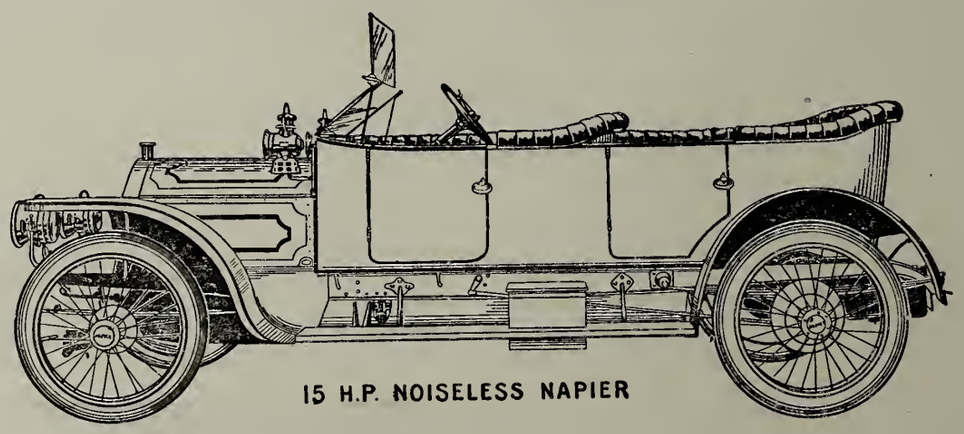
though expensive, treatment up to the present to combat this nuisance in Johannesburg and district has been the use of tar veneering. The sprinkling of streets, customary in sea-coast towns, with salt water, whereby a crustation is formed on the road surface, has proved most efficacious in dust laying, and the suggestion of

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15 H.P. NOISELESS NAPIER

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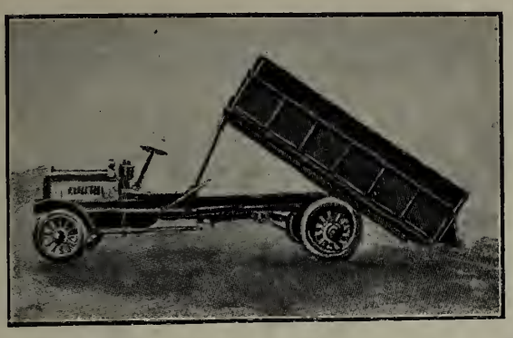
Gill's Garage

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experimenting on the Rand roads with water mixed with salt may assist in the solution of the dust problem.

The difficulty experienced by the motorist of obtaining supplies on extended tours in the past has been satisfactorily overcome by the establishment of depôts on the more frequented routes throughout the Union; the



Motor Tip Wagon as supplied to the Johannesburg Municipality

much-travelled motorist, however, leaves very little to chance, even now, and wisely equips for any emergency which may arise, despite the fact that at most towns, however remote, supplies can be obtained and general repairs invariably effected. This fact lends additional interest to the new enterprise which motoring has created, and reflects in practical manner the growth and importance of the industry.

The Transvaal Automobile Club, which is affiliated with the R.A.C., was founded some ten years ago, and is an organisation with numerous commendable objects and possessing many advantages. Primarily instituted with a view to encouraging and developing the motor and other allied industries in this country, it furnishes its members, when practicable, with a social club and a centre of information and advice on various matters pertaining to motor vehicles, affording them support in the protection and defence of their rights whenever menaced. In character it is essentially a members' club, conducted independently of any personal interests. Its constitution consists of a president, two vice-presidents, a club committee, and of life, honorary, ordinary, and associate members. Not the least of the many advantages which identification with the club embraces are the special trade discounts the association endeavours to procure in the purchase, etc., of motor vehicles. A provision also greatly appreciated by members is one which entitles the colonial motorist, when visiting the United Kingdom, to the privilege of affiliation, during his stay, with the Royal Automobile Club of Great Britain and other societies.

The Transvaal Automobile Club, inter alia, evinces the keenest interest in the good roads propaganda, and to its influence and untiring efforts much of the development of late in the district road system in particular is due, the club at all times advocating the policy that the triumph of the car is largely subject to the betterment of the roadways of the country.

From time to time many excellent motor competitions are arranged for, which have done so much to popularise the sport of motoring, in addition to affording the public an insight to the sterling qualities of the competing cars and their respective capabilities on the highroads of South Africa, for it must be remembered that the favourable track conditions obtaining in other countries are at present denied the motor-racing enthusiast in these parts.

Tours and excursions are also arranged periodically under the club auspices for the benefit of members and friends, a social feature much appreciated and productive of great good.

The club is fortunate in having elected for its president the worthy occupier of the Johannesburg civic chair, a gentleman deeply interested in the good-roads movement, and one who seldom misses an opportunity in his mayoral capacity of voicing the club's views on this all-important question.

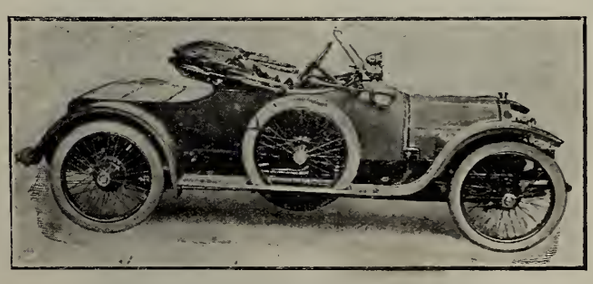
The conservatism which marked the introduction of the commercial motor has received its deathblow, so to speak, by the unique adaptability of that machine, a magic characteristic which determines the success of so many products of industrial enterprise. The motor delivery van has materially assisted to solve the transport problem of South Africa, rendered acute by reason of the scourge of horse-sickness and other causes, which fact alone ensures for this form of locomotion a prominent place in the category of the public service. The colonial models are specially constructed to climb the steepest hills and negotiate the roughest roads and tracks without wavering, and generally conform to the conditions, as varied as exacting, peculiar to South Africa. The manufacturers of these vehicles appreciate the fact, for example, that a tractor capable of affording the acme of satisfaction in a country where road surfaces are usually above reproach may signally fail in this respect when subjected to colonial road conditions, and in consequence specialise in point of colonial requirements.

The South African Railways were among the first to recognise the economic value of the petrol motor and adopt such transport, their clear-headed policy auguring well for that wider adoption which to-day characterises this form of locomotion.

The fire service of which Johannesburg is justly proud owes its present efficiency largely to the introduction of the petrol motor fire engines and escapes, which have superseded the horse-drawn apparatus, and operate so expeditiously in town, or, when occasion arises, at any point, however distant, on the great Reef belt.

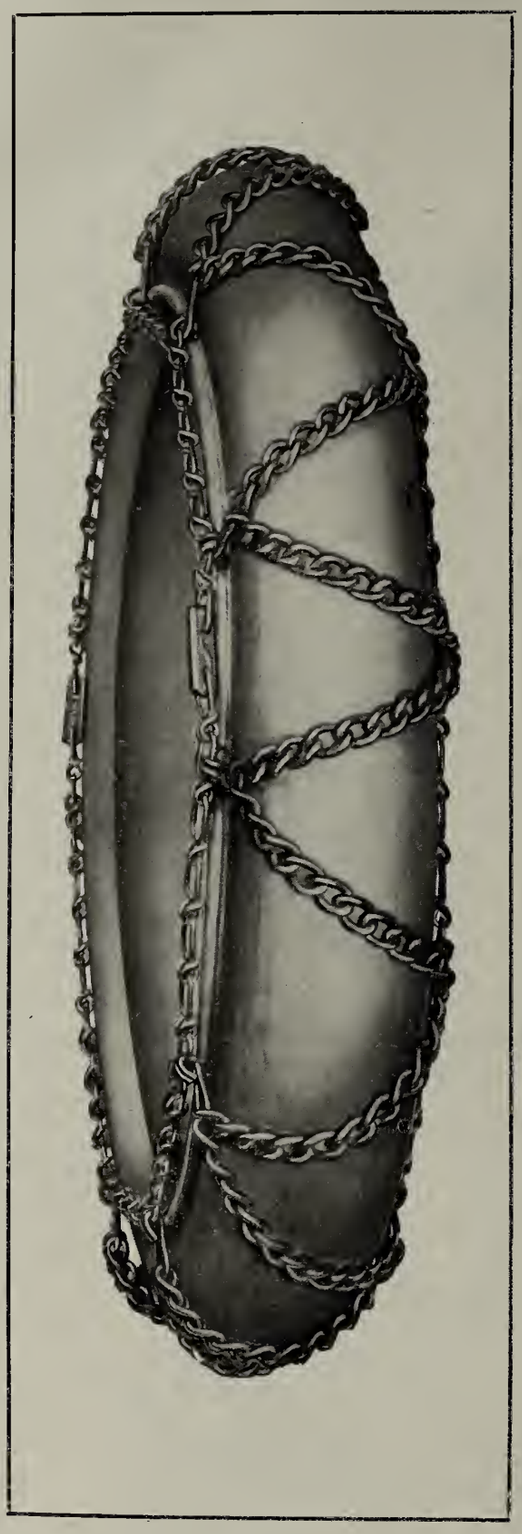
Motor ambulances, as opposed to the horse-drawn contrivances, also serve an excellent purpose, being often called upon to perform long journeys into the districts, rendering first aid with a minimum of delay, the special springing and maximum provision for comfort bearing no comparison with the equine prototypes of an earlier date. Expert opinions in regard to the motor ambulance, it is interesting to remark, state that this machine should be designed to proceed at a comparatively slow rate; high speed, it being pointed out, is in no way essential to the operation of such a vehicle. The employment of pneumatics in twin form is advocated, but the provision for carrying an invalid on a spring-mounted frame or stretcher is discountenanced: the best precaution against discomfort centreing, according to the experts' views, in the avoidance of high speed.

Many additional public services are at present expedited with the aid of the petrol motor, such as scavenging, etc., which space at disposal, however, will



New pattern Riley 12-18 h.p. two-seater car.

not permit a description of. The Tramway Departments of Johannesburg and other cities find the motor tower wagon indispensable for repair work, much of which, as is well known, is rendered necessary during the summer season on account of the frequent vagaries of lightning, where under other circumstances congestion



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A CAR equipped with PARSONS NON-SKID CHAINS will go anywhere — through sand, mud, wet grass, and even where no roads exist. Parsons Non-Skid Chains give the car wheels a tractive grip unattainable by any other means. The facts that in the United States of America no less than 408,694 Parsons Non-Skid Chains were sold during the year 1911, and that Australian and South American Motorists ALWAYS carry them on their cars prove their worth for use in South Africa.

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Will enable you to mend a Puncture in one minute. A PARSONS RAPID REPAIR is a a **permanent** repair.

No skill is required. Weight of Kit, 1lb.; Size, 7 in. by 4 in. Just fits the pocket.

Ask your Motor Agent for Parsons Non-Skid Chains and Rapid Repair Kit. Catalogue mailed free on request.

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of the entire tram system in the thunderstorm season would ensue.

Commercial firms are proving on careful analysis of mileage that the costs in regard to horse van transport are much in excess of the motor service, and it is daily more evident that the latter will in time substitute, in wholesale fashion, all horse-haulage methods. The South African agents for the various delivery vans anticipate a big trade in the future in these vehicles; in fact, the demand at present is quite consistent with the available supply. These commercial cars, in most instances, are sold on arrival, while the indent ordering is very considerable in this connection.

Further, the adoption of motor tractors for ploughing, reaping, threshing, and general farm work is very noticeable in the several colonies, and will yet reveal to the world the genuineness of the immense agricultural prospects which South Africa offers to the settler. The incalculable advantage of the farm motor must eventually become patent to the agriculturist who by its use can dispense with cattle, and be relieved, incidentally, of the wearying slowness which their employment entails. Primitive methods on the farm, and as in other pursuits, must yield to the expansion the petrol motor ensures, and when comparisons are attempted in regard to working costs, it will be found that the balance is overwhelmingly in favour of the new motive power.

Perhaps the most important of all considerations in point of the South African motorist is the tyre, and the production of a suitable type for this country is taxing the various manufacturers to the utmost. South African roads exact a combination of strength, resiliency, and endurance not always obtainable in the single structure of a tyre. Such, however, the existing conditions demand, and before any claim to success is attempted, a tyre must embody the foregoing characteristics. In regard to the selection in point of best service, much depends upon the speed, weight, and power of the car to which the tyres are fitted, and the owner is invariably the best informed to decide this question, and also the type, whether plain tread, grooved, or corded. Whatever the selection, the cover must be specially constructed to withstand the terrific strains of South African roads, while the tube must be of a kind enabled to resist sudden compression through swift progress over bad roads, and ward off successfully the many outside blows transmitted through the cover.

"Lorgnette."

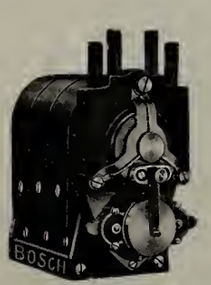
A significant feature in a reflection on the recent Grand Prix is apparent in the fact that every car in that classic event was fitted with a Bosch magneto, which proves conclusively that this world-famous ignition has the complete confidence of the designers and manufacturers of the competing cars, which may be defined as the cream of the world's automobiles. This fact will be appreciated by every motorist; and from what can be gathered, the "Bosch" has an almost exclusive field of operation in South Africa, where tests of endurance are more or less daily commonplaces in regard to many cars, owing to the undeveloped roadways which in particular characterise the "district" parts of the sub-continent.

The attention of the entire motorist world was directed some little time ago to the "top speed" run undertaken by the Napier car of one thousand nine hundred and twenty-eight miles—London, Land's End, John o' Groats, Edinburgh, London—under Royal Automobile Club observation. Parts of this great run, for example, the Berriedale Hill, were never before negotiated on top speed by any machine; the severity of the test is therefore indisputable, and the highly satisfactory performance of the Napier in accomplishing the remarkable feat on an average petrol consumption of twenty-three and nine-tenth miles per gallon stands out unique in the annals of automobilism. The Napier, it may be remarked, already ranks high in the estimation of the South African motorist, and the special study of the peculiar requirements of this country which Mr. Edge, the director of the famous Napier factory, assiduously grappled with during his special visit to this country will be reflected shortly in the "Colonial" Napier on its introduction to South Africa.

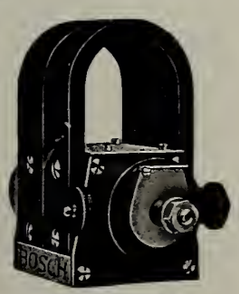
The choice of a motor spirit is always important to the motor-car owner, but in the case of the South African motorist it becomes a matter of the greatest moment when one has respect to the conditions obtaining. A spirit which can be relied upon not to fail on the big hills with which this country abounds is, in short, the only spirit worthy of consideration in the sub-continent. The manufacturers of the volatile "Texaco," therefore, have reason to feel complimented, on analysis of the various spirits, on the excellent results obtainable from their product, which, by the way, is rapidly monopolising the trade in this commodity and is having a wide recognition accorded to it as a spirit of unfailing power, a feature of such vital importance to the South African motorist, who is faced with conditions more exacting than obtain in most other countries of the world.

The increasing cost of petrol is viewed by all motorists at the present time with an unusual concern, and has brought into prominence once again the possibilities of the paraffin carburettor. Many carburettors, however, are so designed that the heavier spirit, paraffin, can be used to advantage. The White and Poppe, for example, answers admirably this two-fold purpose, and is widely adopted for this particular reason by manufacturers of touring and commercial motor vehicles. Its employment for engines subjected to heavy loads over extended periods has long been recognised.

F. HOPPERT
(ESTABLISHED 1894)
Electrical Engineer and Instrument Maker ::
Sole Representative for South Africa for
BOSCH MAGNETO IGNITION
Large Stock of Magnetos :: Spare Parts of all descriptions :: Spare Part Travelling Cases :: SPARKING PLUGS of the latest type :: High and Low Tension Cable stocked



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Perhaps in no other country in the world is the tyre question so acute as in South Africa. This is apparent by a study of the road conditions to which, it may be remarked, of late much serious attention has been devoted by manufacturers. Many years, however, must elapse before the road system of this country can lay claim to equality with those of countries of an older civilisation, and the point at issue for the motorist is, how best to guard the tyre in the interim. In the Duval Protectotire, to mention one of the many tyre life-preserving devices with a claim to recommendation, the motorist is experiencing a boon, this fitment extending the life of tyres in a truly remarkable manner. It consists of a specially woven, light fabric in the form of a shield, easily attachable to the cover, and, unlike many devices marketed with a similar end in view, does not militate against general efficiency. Covers fitted with these bands are practically immune from punctures and bursts, and are preserved to a wonderful degree from abrasions, even on the very roughest roads.

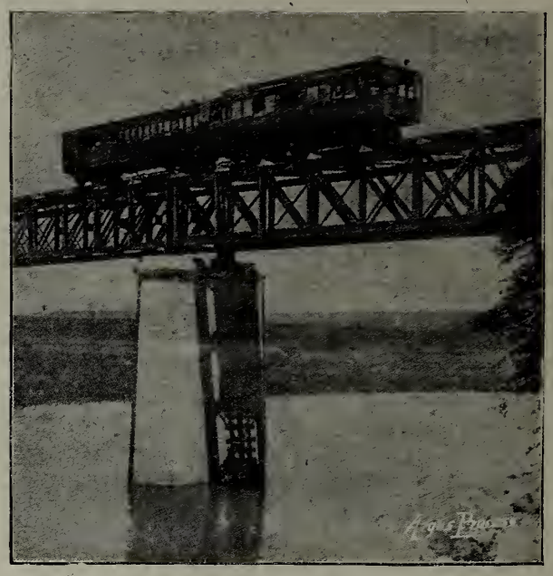
The manufacturers of the Continental tyre are making a bid for the South African trade altogether praiseworthy, and which is meeting with a richly-deserved success. The tyre, to meet Colonial requirements, it need hardly be pointed out, must of necessity be of a high order, offering the essential combinations which count for efficiency and durability for every kind of service, and it is becoming common knowledge that the very best service under the most trying conditions is afforded in the Continental. The enormous strength



One of the "Sunbeam" Fleet driven in the Grand Prix

which enables these tyres to endure incessant strains and still record satisfactory mileage results underlies, in the main, the success referred to.

In view of the approaching wet season, motorists need scarcely be reminded of the indispensable qualities possessed by the Parson's non-skidding chains. No device introduced in the past has proved so capable of eliminating in such effective manner th edanger which slippery road surfaces entail as the non-skid chain in question. These chains, manufactured in varying sizes, are easily carried, and can be fitted with a minimum of delay to wheels of any dimensions. Too much reliance



Motor Train on a South African Railway Bridge

is placed upon the steel-studded tyre by many motorists to avoid skidding. The experience of the South African motorist will endorse the statement that occasions often arise when the studded article proves as ineffective in dealing with the skid as the plain-tread tyre. In addition, it may be mentioned, that the heat to which tyres are subjected in South Africa—especially in the inferior product—causes the studs to drop out, offering, in the natural way, an excellent opportunity for the work of disintegration. The most important service, however, rendered by the Parson's non-skid chain is forcibly demonstrated by its action in the soft ground so often encountered in the sub-continent during the respective rainy seasons. In this connection its effectiveness is unique.

The Transition of the Cycle in South Africa.

In the chrysalis stage of the cycle industry, somewhat over two decades ago, the pioneers of Johannesburg found a certain relaxation in trying conclusions with the fifty-six-inch high ordinary, before the advent of roads, with results which must be entirely

DOUBLE THE LIFE OF YOUR TYRES AND PREVENT PUNCTURES

THE DUVAL PROTECTOTIRE

(PATENT).

A BOON TO MOTORISTS.

IT LASTS FOR YEARS

Prevents Punctures and Bursts. Adds at least 2,000 miles to life of tyres. Enables you to use your covers to last layer of canvas. Does not creep or pinch, is very light and can be carried in tool box. Made of specially woven fabric with tough rubber face, which has taken years to perfect.

CAN BE USED OVER AND OVER AGAIN

SATISFACTION GUARANTEED. ALL SIZES FOR CARS AND MOTOR CYCLES. HUNDREDS OF TESTIMONIALS.

Price List and interesting pamphlet on application.

DUVAL TYRE CO. (S.A.)

P.O. Box 834. Head Office: FLETCHER'S CHAMBERS, CAPE TOWN

left to the imagination. So far as can be ascertained, there is no record of the "bone-shaker," a machine which preceded the "ordinary" in other parts, ever having been introduced locally to test the equanimity of the early settlers, as the literal acceptation of the name suggests. This velocipede, it will be remembered, was propelled by bringing the feet in contact with the road, and later on by the action of pedals.

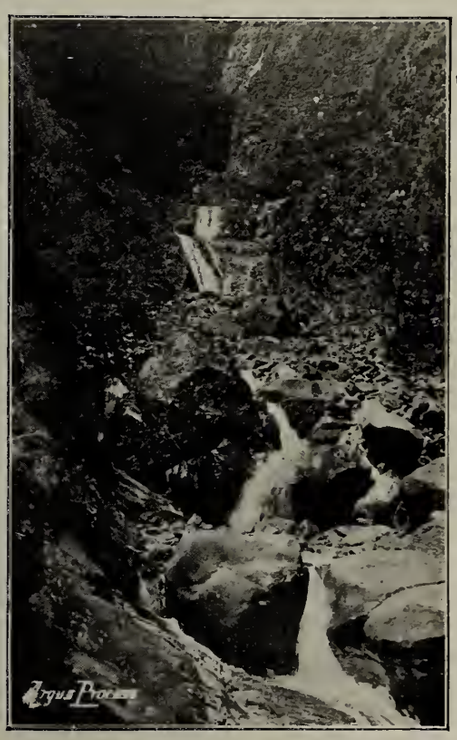
Following on the "ordinary," in these parts, came the single-tube, canvas-lined type of cycle, a machine fruitful of much worry owing to the difficulty of locating and repairing punctures which it involved. Experience of a more gratifying nature than was possible with the latter marked the advent of the cushion tyre, which, however, was relegated to comparative obscurity directly the pneumatic machine was marketed. This, with its one and three-quarter-inch tyres, fixed wheel, and conspicuous handle-bars, in the region of two feet six inches in width, was very well received, until superseded by the type with the added and welcome innovations of the free-wheel and front brake. Success followed success, and later the improved free-wheel, with back and front hand-applied brake, was occupying public attention, which was soon to be diverted, however, into other channels when the facilities of the back-pedalling-brake machine were recognised. Much valuable service was rendered by the latter until what may be classed as a revolution in the cycle trade was brought about by the change-speed-gear machine, which to-day is luxurious and fitted with two and three-speed arrangements. It is interesting to remark at this juncture that the Johannesburg Municipality issued almost thirty thousand bicycle licences for the year ended June 30th, 1912, which fact forcibly illustrates the popularity of the ubiquitous "bike" in South Africa, despite the facilities afforded by other forms of locomotion, for example, the motor-bicycle, the excellent tramway systems of the many larger towns, and the rapidly increasing train and other services.



South African Scenery; Tugela Gorge



"World's View," Tugela Gorge



Another View of Tugela Gorge

The Motor-Cycle.

From authentic accounts it would appear that the first motor-cycle introduced to Johannesburg was an Ormonde, of two and three-quarter horse-power, about

the year 1900. Its engine was built into a diamond frame, and was capable of developing a speed of over thirty miles per hour wherever road conditions permitted. The difficulties which proved so formidable in those earlier times, brought about by overheating, starting against compression, a lack of control over the carburettor, and other drawbacks too numerous to mention,

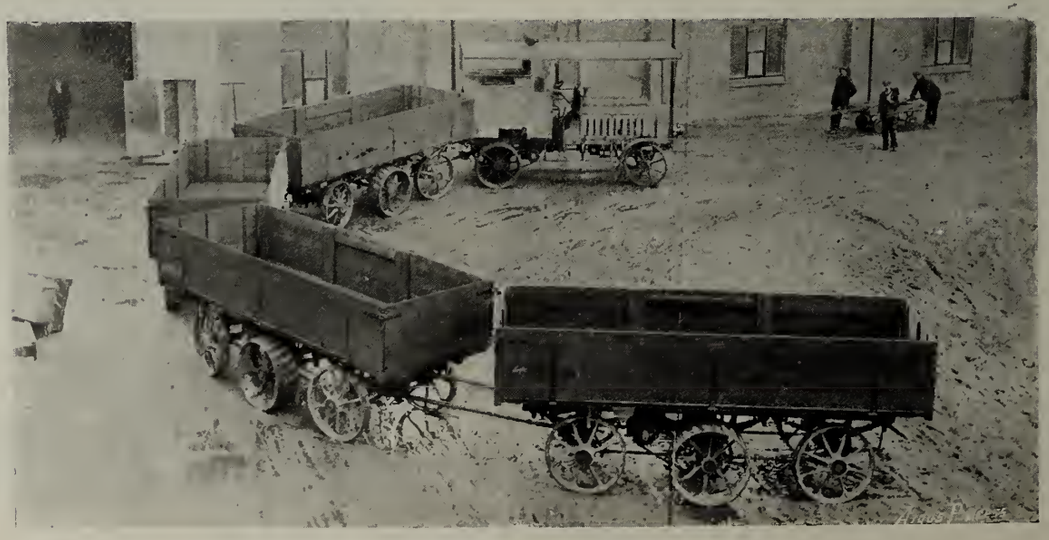


A Maxwell Car in typical tropical country.

stand out in striking contrast to the perfection which to-day characterises the motor-cycle. For a time the industry showed decided signs of languishing, but the adoption of the magneto once again gave a fillip to the trade, which has been steadily maintained down to the present time.

In a country of such an undulating nature as South Africa the future of the motor-cycle is assured beyond any possible doubt owing to its unequalled hill-climbing propensities, and when one reflects that Nature, with lavish hand, has furnished hills of the most formidable type, which in the past had more or less defied all recognised forms of locomotion, the indispensable nature of the modern motor-cycle is apparent. A machine that breasts with ease the steepest gradients in town and country is a priceless adjunct to the business man and the pleasure seeker, and although perfection may seem to have almost been reached in manufacture, the advances of recent years lead to the impression that greater things are yet in store, and that motor-cycle construction, in keeping with all great industries, will still be characterised by surprising improvements. The free engine, by way of illustration, has been marketed with unqualified success, being specially adapted for side-car work, and combining that simplicity and reliability so essential to the popularising of the modern machine. The free engine has also been instrumental, to a great degree, in enticing back to the motorist ranks large numbers of erstwhile enthusiasts who, in the natural order of things, have reached a stage when superfluous energy is at very low ebb, and who, simply on the score of advancing years, have reluctantly relinquished the cycling pursuit, but who now find in the free engine a relief from the exercise incidental to "chasing" a machine over varying distances preparatory to starting the engine—an obvious strain to the person of advancing years.

Space will not permit of reference to the economic and other features which the cycle embodies; in fact, universal recognition in this direction almost precludes any comment which might be attempted. Suffice it to say that the popularity which has been responsible for the wide adoption of the motor-cycle is in no danger of experiencing a set-back so long as the high-class standard of machines imported in the immediate past is maintained.



Daimler Road Train

The Central Mining —Rand Mines Group

CITY DEEP, LIMITED.

Capital, in £1 Shares £1,250,000
Number of Claims ... ... 1,098·817
Situated on the immediate dip of the City and Suburban, Meyer and Charlton, and Wolhuter Gold Mines, on the Central Rand.
200 Stamps and 9 Tube Mills.

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CROWN MINES, LIMITED.

Capital, in 10s. Shares £1,000,000
Issued Capital £940,106
Number of Claims 2,221
Situated on the Central Rand.
Number of Stamps 835
And 26 Tube Mills.

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DURBAN ROODEPOORT DEEP, LIMITED.

Capital, in £1 Shares £450,000
Issued Capital £440,000
Number of Claims 273,735
Number of Stamps 100
And 3 Tube Mills.

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H. C. Boyd	,,	M. Honnet.

CONSULTING ENGINEER. P. Cazalet.

MANAGER AT MINE. A. P. Rouillard.

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Compagnie Francaise de Banque et de Mines, 20, Rue Taitbout.

RAND MINES, LIMITED.

Capital £550,000
Issued Capital ... ... £531,498 15s.
In 2,125,995 shares of 5s. each.

Property.—The Company has 1,256·15 claims still unfloated, the farm Mooifontein, Langlaagte freehold, and has large holdings of shares in its subsidiary companies, all deep levels, situated chiefly on the Central Rand. The Company also has considerable interests in other companies. The aggregate issued capital of its six subsidiary companies is £4,403,080, their total claim area being 4,273·705, and their complement of stamps 1,915 and 41 tube mills.

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Sir S. Neumann	,,	W. H. Dawe.
H. Mosenthal	,,	E. Chappell.
E. J. Renaud		

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FERREIRA DEEP, LIMITED.

Fusion of the Ferreira Gold Mining Company, Central Rand, with Ferreira Deep.

Claims 207,587
Number of Stamps 280
And 7 Tube Mills.

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H. A. Rogers.		
R. W. Schumacher	,,	M. Honnet.
E. A. Wallers	,,	H. Eckstein.

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GELDENHUIS DEEP, LIMITED.

Capital, in £1 Shares £600,000
Issued Capital £585,753
Number of Claims 876,115
Situate on East Central Rand.
Number of Stamps 420
And 7 Tube Mills.

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C. Meintjes	,,	Comte. F. de Ferrieres.
J. E. Allingham		
M. G. Elkan	,,	H. Neuhaus.

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FRENCH RAND GOLD MINING COMPANY, LIMITED.

Capital, in £1 Shares £560,000
Issued Capital £514,000
506.487 claims, 3 mining stands and 9 water rights on farms Witpoortje and Luipaard's Vlei, West Rand.
Number of Stamps 120

DIRECTORS.
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P. Dreyfus	,,	J. L. Jourdan.
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BANTJES CONSOLIDATED MINES, LIMITED.

Capital £600,000
Issued Capital £502,306
In 502,306 Shares of £1 each, fully paid.
Property: 820·502 claims with Township of Florida, and freehold of portion of farm Vogelstruisfontein; also 4 water-rights; 100 stamps; 3 Tube Mills.

DIRECTORS.

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W. H. Dawe	,,	A. G. Gill.
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NEW MODDERFONTEIN GOLD MINING CO. LTD.

Capital £1,400,000
In 350,000 shares of £4 each, all issued.
Number of Claims: Mynpacht equal to 172·8 claims, 1,061·116 claims, and mining rights under water-rights, equal to 48·9715, Claims and 3 water-rights on Farms Modderfontein and Benoni.
Number of Stamps 180
And 7 Tube Mills.

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J. G. Currey	,,	J. H. Ryan.
W. H. Dawe	,,	A. G. Gill.
W. T. Graham	,,	M. Honnet.
F. von Hessert	,,	P. Dreyfus.
J. Köster	,,	G. Sonn.

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MODDERFONTEIN B. GOLD MINES, LIMITED.

Capital, in £1 Shares (all issued) £700,000
Number of Claims 1,467
(67 north of outcrop).
Situate on farm Modderfontein No. 167; freehold of claims and remainder of farm, in all, 4,514 morgen.
80 Stamps and 5 Tube Mills.

DIRECTORS.

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C. Meintjes	,,	S. M. Nelson.
E. A. Wallers	,,	M. Honnet.
H. C. Boyd	,,	F. Boerckel.
M. G. Elkan	,,	H. Neuhaus.
W. H. Dawe	,,	A. G. Gill.

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E. C. Clifford.

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NOURSE MINES, LIMITED.

Capital, in £1 Shares £850,000
Issued Capital £827,821
Number of Claims 647
Situated on the Central Rand.
Number of Stamps 260
And 7 Tube Mills.

DIRECTORS.

H. C. Boyd (*Chairman*)	*alternate*	H. Eckstein.
R. W. Schumacher	,,	C. Meintjes.
A. G. Gill	,,	W. H. B. Frank.
W. T. Graham	,,	M. Honnet.
E. J. Renaud	,,	J. L. Jourdan.
H. Nourse	,,	J. H. Rainier.
S. C. Black	,,	B. Moses.
F. D. P. Chaplin	,,	F. L. Brown.

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MANAGER AT MINE. R. A. Barry.

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ROBINSON GOLD MINING COMPANY, LIMITED.

Capital, in £5 Shares (550,000 Shares) £2,750,000
Number of Claims 172
Situated on the farm Turffontein, west of and adjacent to the town of Johannesburg.
Number of Stamps 250
And 6 Tube Mills.

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Comte F. de Ferrières.		
R. W. Schumacher	,,	C. Meintjes.
H. C. Boyd.	,,	M. Honnet.
H. Eckstein.	,,	C. Distel.

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L. Wagner	,,	P. Troquet.

MANAGER.—Palmer Carter.

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PARIS CORRESPONDENTS.
Banque de Paris et des Pays-Bas, 3, Rue d'Antin, Paris.

ROSE DEEP, LIMITED.

Capital, in £1 Shares £700,000
Number of Claims ... ... 365·2988
Situated on the Dip of the New Primrose property, East Central Rand.
Number of Stamps 300
And 7 Tube Mills.

DIRECTORS.
H. Eckstein (*Chairman*).

R. W. Schumacher	*alternate*	F. Boerckel.
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M. Honnet	,,	C. Mentjes.
E. J. Renaud	,,	J. L. Jourdan.
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W. Pott.	,,	J. Davidson.

LONDON COMMITTEE.

C. Rube	*alternate*	F. Davies.
L. Wagner	,,	A. T. Schmidt.
Admiral Sir A. H. Markham, K.C.B.	,,	P. Troquet.

CONSULTING ENGINEER. R. Raine.

MANAGER AT MINE. A. J. Walton.

SECRETARIES AND HEAD OFFICE.
Rand Mines, Ltd., The Corner House, Johannesburg.

LONDON SECRETARY AND OFFICES.
A. Moir, 1, London Wall Buildings, London, E.C.

PARIS REPRESENTATIVES.
Compagnie Française de Banque et de Mines, 20, Rue Taitbout.

GLYNN'S LYDENBURG, LIMITED.

Capital, in £1 shares £175,000
Only 170,000 Shares are issued.

The Company owns the following property on Farm Grootfontein, No. 1,327: Freehold portion, in extent 2,839 morgen, 501 square roods; Mynpacht No. 460, in extent 260 morgen, 69 square roods; Mynpacht No. 449, in extent 238 morgen, 433 square roods, and 168 Mining Claims.
The Company holds the freehold of 2,840 morgen.
Number of Stamps 20
which are worked by water power.

DIRECTORS.

H. C. Boyd (*Chairman*)	*alternate*	H. Eckstein.
J. H. Ryan	,,	B. Southwell.
E. A. Wallers.	,,	C. Meintjes.
E. F. Bourke	,,	B. T. Bourke.
H. T. Glynn	,,	Evelyn W. Smith
A. Mackie Niven	,,	R. Niven.
Sir A. Woolls-Sampson, K.C.B., M.L.A.	,,	F. Boerckel.

LONDON COMMITTEE.

C. Rube	*alternate*	G. S. Fort.
T. J. Milner	,,	F. Davies.
A. T. Schmidt.		
L. Wagner	,,	P. Troquet.

MANAGER.—G. C. Damant.

SECRETARY. W. Russell Slack.

LONDON SECRETARY. A. Moir.

HEAD OFFICE.
The Corner House, Johannesburg, Transvaal.

LONDON OFFICE.
1, London Wall Buildings, E.C.

TRANSVAAL CONSOLIDATED LAND AND EXPLORATION COMPANY, LIMITED.

Capital, in £1 Shares £1,000,000
Issued Capital £971,214

Property.—The Company owns farms in various districts in the Transvaal, including the East Rand, Pretoria, Heidelberg, Rustenburg, Waterberg, and Lydenburg, having an area of about 3,300,000 acres. It also has town properties in Pretoria and other towns in the Transvaal, and all the issued capital of the Braamfontein Company, Limited.

DIRECTORS.

H. C. Boyd (*Chairman*)	*alternate*	H. Eckstein.
J. A. van der Byl	,,	C. Meintjes.
J. Jeppe	,,	A. Barker.
E. A. Wallers	,,	M. Honnet.
W. H. Dawe	,,	A. G. Gill.
S. Marks	,,	G. Falcke.
B. T. Bourke	,,	E. F. Bourke.

ENGINEER. J. Jervis Garrard.

LAND MANAGER. C. A. Madge.

LONDON COMMITTEE.

C. Rube	*alternate*	L. Wagner.
F. Voelklein	,,	C. J. Ford.
J. L. Bergson	,,	A. Fuller.
A. T. Schmidt.		

SECRETARY AND HEAD OFFICES.
L. G. Heard, The Corner House, Johannesburg.

TRANSFER SECRETARIES.
Rand Mines, Ltd.

LONDON SECRETARY AND OFFICES.
Andrew Moir, 1, London Wall Buildings, E.C.

TRANSVAAL GOLD MINING ESTATES, LIMITED.

Capital, in £1 Shares £640,000
Issued Capital £604,225
Leaving 35,775 Shares in reserve.
Debentures (5 per cent.) £124,000
Property.—About 177,332 acres, including 891 mining claims, with water rights, etc., in the Lydenburg district of the Transvaal.

Batteries.—60 Stamps and 2 Tube Mills at Central Battery, 5 Stamps at Elandsdrift Mine, and 10 Stamps at Vaalhoek Mine.

DIRECTORS.

H. C. Boyd (*Chairman*)	*alternate*	H. Eckstein.
J. H. Ryan	,,	B. Southwell.
Sir A. Woolls-Sampson, K.C.B.	,,	F. Boercker
S. Evans	,,	S. M. Nelson.
B. T. Bourke	,,	E. F. Bourke.
E. A. Wallers	,,	C. Meintjes.

DIRECTORS IN LONDON.

Nicol Brown	*alternate*	M. T. Brown.
Sir Bartle C. A. Frere, Bart.		
C. Pakeman.		

LONDON COMMITTEE.

C. Rube.		
P. Troquet	*alternate*	C. J. Ford.
L. Wagner	,,	A. T. Schmidt.

GENERAL MANAGER.—S. Aimetti.

SECRETARY. W. Russell Slack.

LONDON SECRETARY. A. Moir.

HEAD OFFICE.
The Corner House, Johannesburg.

LONDON OFFICE.
1, London Wall Buildings, E.C.

PARIS CORRESPONDENTS.
Compagnie Francaise de Banque et de Mines, 20, Rue Taitbout.

"THE JUMPERS" GOLD MINING CO., LTD.

Capital, in £1 Shares £100,000
Number of Claims 39
On the reef and 16½ north of reef, situated on the farm, Doornfontein, Central Rand, East of Johannesburg, and 102,700 Shares in Benoni Consolidated Gold Mines, Ltd.
Number of Stamps 120

DIRECTORS.

S. C. Black *(Chairman)*	*alternate*	B. Moses.
H. P. Rogers	,,	M. Dodd.
H. O'K. Webber *(Managing Director)*	,,	A. Payne-Gallwey.
W. T. Graham.		
Comte F. de Ferrières.		
E. Friedlander	,,	F. Elkan.

SECRETARIES.
Compagnie Francaise de Banque et de Mines.

LONDON AGENTS.

Chas. Rube	*alternate*	G. S. Fort.
F. Voelkein	,,	J. L. Siddall
T. J. Milner	,,	L. Wagner.

LONDON SECRETARY AND OFFICES.
Andrew Moir, 1, London Wall Buildings, E.C.

HEAD OFFICE.
Exploration Building, Johannesburg.

PARIS CORRESPONDENTS.
Compagnie Francaise de Banque et de Mines, 20, Rue Taitbout.

THE CITY AND SUBURBAN GOLD MINING AND ESTATE COMPANY, LIMITED.

Capital, in £4 Shares (340,000 shares) £1,360,000
Property.—135 Claims and the Freehold of the whole of their property of 454 acres, on which a township adjoining Johannesburg is laid out, 666 stands having been sold on 99 years' lease; 40 stands are still held. Situated on Central Rand.
Number of Stamps 160

DIRECTORS.
Hugh Parker, *Deputy Chairman*.
P. Davis, P. F. Payn, W. J. O'Brien, W J. Shaw, Lovell Greene.

MANAGER.
Charles Glyn.

SECRETARY.
W. M. Hunter.

LOCAL BOARD AT JOHANNESBURG.
Max Honnet, H. O'K. Webber, Hermann Eckstein.

MINE SECRETARY. W. A. Heale.
CONSULTING ENGINEER. Sydney J. Jennings.

LONDON OFFICE.
96, Gresham House, Old Broad Street, E.C.

LONDON AGENTS.
G. H. Raw, L. Wagner, Walter G. Izard, John S. Sheldrick.

LONDON SECRETARY.
F. T. Pressland.

HEAD OFFICE.
Pietermaritzburg, Natal.

NIGEL GOLD MINING COMPANY, LIMITED.

Capital, in £1 Shares £224,000
Issued Capital £223,106
Property.—Farm Varkensfontein, 5,600 acres in extent, including mynpacht, and 176 claims on Varkensfontein and Bultfontein. In addition to Gold Mining, the Company has coal workings on its property.
Situated in the Heidelberg District.
Number of Stamps 75

DIRECTORS.
L. Line, *Chairman*.
P. F. Payn, J.P. Hugh Parker. W. J. O'Brien.
Orlando Hosking. G. E. Greene.

LOCAL DIRECTORS AT JOHANNESBURG.
F. Hathorn. John Roy.

LONDON AGENTS.
G. H. Raw, *Chairman*.
L. Wagner. W. G. Izard. John S. Sheldrick.

SECRETARIES AND HEAD OFFICE.
J. Weightman, Bank Street, Pietermaritzburg, Natal.

LOCAL SECRETARY AND TRANSFER OFFICES.
Harold Duncum, Johannesburg.

LONDON SECRETARY AND OFFICES.
F. T. Pressland, 96, Gresham Hause, E.C.

VILLAGE DEEP, LIMITED.

Capital, in £1 Shares £1,060,671
Number of Claims ... ... 535·1391
Situated on the Central Rand, South of the Village Main Reef property, and adjacent to Johannesburg.
Number of Stamps 180
And 6 Tube Mills.

DIRECTORS.

H. C. Boyd *(Chairman)*	*alternate*	H. Eckstein.
R. W. Schumacher	,,	C. Meintjes.
F. D. P. Chaplin	,,	F. L. Brown.
R. R. Hollins	,,	John Jolly.
W. H. Dawe	,,	W. H. B. Frank.
J. H Ryan	,,	B. Southwell.
E. A. Wallers	,,	M. Honnet.
C. Marx	,,	P. Richardson.

LONDON COMMITTEE.

Chas. Rube	*alternate*	F. Davies.
R. R. Hollins	,,	H. P. Griffiths.
L. Wagner	,,	P. Troquet.

CONSULTING ENGINEER.
R. Raine.

MANAGER. J. Whitehouse.
SECRETARIES. Rand Mines, Ltd.

LONDON SECRETARY AND OFFICES.
Andrew Moir, 1, London Wall Buildings, E.C.

HEAD OFFICE.
The Corner House, Johannesburg.

PARIS REPRESENTATIVES.
Compagnie Francaise de Banque et de Mines, 20, Rue Taitbout.

THE NEW HERIOT GOLD MINING COMPANY, LTD.

Capital, in £1 Shares £115,000
Issued Capital £115,000
Number of Claims 52
Situated on the Central Rand, between the Henry Nourse and Jumpers Companies.
Number of Stamps 70

DIRECTORS.
Hugh Parker, *Deputy Chairman*.

R. H. Raw.	G. J. Macfarlane.
P. F. Payn.	W. J. O'Brien.
J Waldie Pierson.	Lovell Greene.

SECRETARY, Mr. W. M. Hunter.

LOCAL BOARD AT JOHANNESBURG.
J. Waldie Pierson. H. O'K. Webber. H. C. Boyd.

CONSULTING ENGINEER. S. J. Jennings.
MINE SECRETARY. J. B. Holgate.

LONDON OFFICE.
96, Gresham House, Old Broad Street, E.C.
LONDON SECRETARY, J. S. Sheldrick.

LONDON AGENTS.
G. H. Raw. L. Wagner. F. J. Dormer.
D. J. Pullinger.

HEAD OFFICE.
Pietermaritzburg, Natal.

THE RAND MINES OUTLOOK.

The Rand Mines annual meeting recently provided the Chairman, Mr. Schumacher, with the opportunity to review the industrial features of the year, to make several anncuncements of some novelty, and to reiterate the confidence of the chief controlling house in the future of the Rand. The absence of any reference to politics, *qua* politics, and the brevity of the remarks dealing with native labour, distinguished Mr. Schumacher's speech from that made on the same occasion in former years. Lengthy as is this year's speech, and detailed as it may, in places, necessarily be, the shareholder and the student of Rand economics can afford to miss no part of it. Mr. Schumacher's brief review of the position and prospects of the individual mines of the Rand Mines Group is as succinct and compact of information as such a review well can be. Regarding general progress during the year, Mr. Schumacher spoke without undue enthusiasm. The big programme of reform sketched by him last year, he admitted, was still far from completion. Indeed, its ambitious nature entailed non-fulfilment at so early a stage. "We have only had time to achieve partial success," he said. "We have, though, already improved, and we think permanently improved, the working conditions of some of our important mines, and these improvements are indicative of further progress that is to follow. At other mines we have not been able to make as rapid an advance; conditions everywhere are not equally favourable, and in some cases more time is required to achieve success than in others; but everywhere the signs are not wanting that we are working on right lines. I deal first with the mines where the better results are most marked—mines that are already working at ease, if I may use the expression; that is, without constant and undue pressure, which is never conducive to good work." On the big questions that concern all the mines equally, such as metallurgy, power supply, native labour, phthisis, housing, bewaarplaatsen, and taxation, Mr. Schumacher had many true and authoritative and several new and interesting things to say. In metallurgy, owing principally to the introduction of the Butters' filter and to more efficient tube-milling and classification, Mr. Schumacher was able to point to the number of improvements that have been effected; and to the fact that the recovery of dissolved gold is regarded as practically complete, the loss, as compared with that in the old decantation process, being almost negligible. His remarks on the subject of economy of labour underground, though brief, indicated that directors are at last fully alive to what is a notoriously weak spot in the industry. "The labour position generally, he said, "is more favourable to-day than it has been recently, but some of our mines have been, and still are, hard pressed, for the supply has not kept pace with the ever-increasing demand. I must add, though, that it is the belief of most people who have a thorough knowledge of the subject that

great economies can still be effected in the use of native labour, especially underground, where it is chiefly employed. The organisation and control of native labour on the mines is not everywhere as perfect as it might be, and this is a point to which we call the special attention of our mine managers." That a steadily increasing use is being made of small machine drills is proved by the following comparison drawn from the mines of the Rand Mines group: The percentage of tonnage from stopes in December, 1910, was:—By large machines, 57 per cent.; by small machines, 3 per cent.; by hammer boys, 40 per cent. In December, 1911, it was 58 per cent., 14 per cent., and 28 per cent. respectively. The excellent housing scheme started at the City Deep bids fair to have many imitators; and it is good news that the Minister of Mines is favourably disposed to the Rand Mines proposals to utilise for model villages the surface rights not required for mining purposes, on other properties. Mr. Schumacher's statement on the intricacies of the power question was detailed, but not more so than the shareholders have a right to expect. The chief features of the settlement that has been come to between the Rand Mines and the Power people are the payment of a lump sum of £35,000 as liquidated damages, and the acceptance of a new form of contract "which appeared desirable in the light of the experience so far gained." Mr. Schumacher's remarks on the phthisis question have already been dealt with; and it only remains to note his conclusions on the outlook in general. No better proof of the confidence of the directors in the future could be adduced than their decision to pay a dividend of 110 per cent. for the current half-year, though Mr. Schumacher admitted that the company had not altogether earned it. "We consider," he said, "that our action is quite justified, in view of the improved results which we expect from our companies before very long." Mr. Schumacher examined, with pardonable pride, the future of the Rand Mines, Ltd. Apart from the possible new discoveries or new assets that may be acquired from time to time, the future of the company lies in the working of the great mines that are of proved value and that own immense stretches of deep level ground. In the Central Rand it commands the deep level ground uninterruptedly from the western boundary of the Crown Mines to the eastern boundary of the Nourse Mines, a distance of over eight miles. The lives of its mines in this central area will not necessarily be limited by their present southern boundaries. Reefs at the southern boundary of the Crown Mines, Ltd., of the Village Deep, Ltd., of the City Deep, Ltd., and Nourse Mines, Ltd., in Mr. Schumacher's opinion, will lie at so great a depth that no new company will ever be formed to work them further to the south and at a still greater depth. This is regarded as tolerably certain owing to the enormous capital expenditure and to the risks that would have to be incurred in starting new mines at vertical depths of, perhaps, 7,000 feet or more. It follows, therefore, that as long as the reefs continue payable in this central and richest portion of the Witwatersrand they will be followed down in the workings of existing deep level mines. We know to-day of no limit that can be placed on the lives of these mines," added Mr. Schumacher; and he went on to point out how the improvements in depth at the City Deep and Turf Section of the Village Deep, coming below extensive poor zones, go to support what has been termed the most encouraging "blotting-pad" theory of the distribution of values in Rand banket. "No limit," he said, "can yet be determined regarding the life of the Witwatersrand, and the future of the Witwatersrand is inexplicably interwoven with that of the Rand Mines, Ltd." Mr. Schumacher's views on the future will naturally command great attention. He said: "I need not dwell on the vast opportunities for expansion and improvement in the extensive mining areas to which I have referred, in which the Rand Mines, Ltd., is vitally interested. It will be realised that these opportunities do exist, and it may, I think, be assumed that we shall not fail to act when we consider that the time is ripe. I need merely say now that the Modderfontein B will not always crush at the rate of only 30,000 tons a month, or the New Modderfontein at the rate of 50,000 tons monthly, or the City Deep at the rate of 60,000 tons, or the Village Deep at the rate of only 52,000 tons; but things cannot be hurried, and people must be very sure of their ground in every respect before any new big programme is entered upon. . . . We have have had a long and arduous climb, and have had to experience serious set-backs and disappointments, such as the repatriation of the Chinese, from time to time; but we are at length approaching the top of the hill. Everything points towards gradually increasing profits, and we feel that if we can gain the goodwill of the Union Parliament the results that will be obtained in the future should surpass all those of the past." These are wise and weighty words, carrying confidence to shareholders, and to the Government the best of advice and warning. The interests of the country are still identical with the interests of the mining industry, and to the progress of the latter are essential not only labour, capital and highly specialised ability, but likewise and not least, the enlightened sympathy of the Government.

THE GREAT CENTRAL MINING SUBSIDIARIES.

The actual returns from the properties of the Central Mining Corporation during 1911, are already familiar to shareholders, owing to the publication, some months ago, of the annual reports. Despite the many difficulties that beset the Rand during recent months, the recent reports, on the whole, make satisfactory reading. The City Deep fully bears out the report by Mr. H. Stuart Martin, written some months ago. In 1911 the mine suffered severely owing to the want of native labour, to the poor efficiency of the underground force, both white and black, and to the lack of compressed air during the earlier part of the year. It was also found that better ventilation, as well as better facilities for the handling of men and material, were required for the upper levels of the mine. At the last meeting, Mr. R. W. Schumacher, the chairman, went into details of the ore developed and underlined the values in the richest section, which extends over 5,000 feet. "This mile of ground," he said, "constitutes probably one of the finest mines in existence." On the question of dividends, Mr. Schumacher said that the cash position was about square at the end of March; that the company had liabilities to be met in the near future amounting to about £45,000; apart from £25,000 for the sinking of No. 1 vertical shaft, and £20,000 to be spent later on the electrification of the hoists at the west shaft. The company is now making profits at the rate of well over £20,000 per month. For the month of May the tonnage milled will be increased to about 35,000 tons from the mine, and it is hoped that the company will be crushing the full 60,000 tons at about the end of the year. It will be seen, therefore that the rate of monthly profits should undoubtedly increase. "It is obvious," said the chairman, in conclusion, "that no dividend will be declared at the end of June next, but there seems to be every likelihood of a small dividend at the end of the current yar. After 1912 shareholders ought to be able to expect with confidence the distribution of regular and satisfactory dividends. I have endeavoured to explain that the general prospects of the mine are bright; that the profits are, as far as we can see, bound to improve; that our legal advisers have no anxiety about the pending law suit, and I trust that shareholders who have been patient so long will bear a little longer that they may reap the full rewards which we firmly believe will now soon come." Mr. H. C. Boyd, who presided at the Village Deep meeting, was able to point to the "very material improvement in the position and prospects of the property." He described the centralisation scheme, which is necessary for the working of the mine in depth, and which should favourably affect working costs. To attain this position, however, he mentioned that further capital expenditure was unfortunately necessary. Something in the neighbourhood of £40,000 have yet to be spent this year. The profits earned to the end of April have amounted to £93,310, making with the special declaration of the gold reserve in March a total profit of £118,065, out of which about £12,000 have been spent on capital account. "Provided development values continue in their present satisfactory position," he said, "a recovery in the neighbourhood of 28s. 6d. per ton on the average can safely be reckoned on. With the higher costs now ruling, due to the necessity of meeting the comparatively heavy underground expenditure out of working costs, it has been deemed expedient to raise the pay limit somewhat for the time being. This entails leaving 175,000 tons of the reserves standing temporarily, but enables us to aim at the grade just mentioned without any danger of reducing the average value of the remaining reserves." He added: "Without attaching too much importance to individual figures, it is obviously extremely encouraging that the bottom of the mine should be giving such satisfactory indications." At the Robinson meeting, the Chairman, Mr. E. A. Wallers, dwelt on the honourable old age enjoyed by the company, despite some natural disabilities. Of the immediate future, Mr. Wallers said: "As to the policy to be pursued during the current year, I would say at once that the object we have in view is to obtain the greatest possible monthly profit consistent with safe working. It is clear to you, I take it, from what we have said, that with the conditions which are inseparable from age, it is necessary to watch things very carefully and modify from time to time, in certain directions, the methods of working. The capacity of your plant enables the treatment of 55,000 tons per month, and if it were possible to fill the plant every month with this tonnage from your rich reefs, and at the same time keep the mine safe, it would be well to do so. We cannot do this, however, because, as I have tried to explain, the blocks of South Reef and Main Reef Leader are becoming steadily more isolated and scattered. We have therefore set ourselves to increase the percentage of payable Main Reef mined, to endeavour to increase the tonnage milled to 55,000 tons per month (the full capacity of the plant), to increase the sands sent down the mine to over 50,000 tons per month, and last, but not least, to try to reduce working costs, so that the Main Reef, which to-day presents but a small margin of profit, shall produce better profits." The Bantjes is experiencing better times. The plant is giving excellent results, and the comparatively small decrease in the ore reserves during last year is of no serious nature. Dealing with the position and prospects for the current year, Mr. Wallers, the chairman, said at the annual meeting: "You will have realised that in your mine, as in others under our control, we are quietly but steadily trying to improve our facilities for the cheaper handling of the ore, and simultaneously to accomplish the work with less unskilled labour. You will have noticed, also, that your financial position at the end of last year, as reflected in the balance sheet in your possession, was satisfactorily clear of all debt. The profits earned for the first four months of this year have amounted to £23,500 (the profit for last month being £6,170), exclusive of the reserve of £2,980 also declared, and we have been considerably short of the tonnage for our full plant capacity. Further, I can assure you that all expenditure will be watched with an exceedingly careful eye, and last but not least, our first declaration of a five per cent. dividend in respect of the current half-year's profit will be made next month." Important changes have been made at the Geldenhuis Deep, and they have proved to be changes for the better. Mr. H. Eckstein put the position very clearly in concluding his speech at the annual meeting. "The whole position," he said, "can be summed up in a few words: Owing to various reasons, which I have fully dealt with, the policy outlined some three years ago for the working of the mine has had to be modified in several respects. We are still in a state of transition, and, that being so, it would be unwise to venture any prediction at this juncture as to the immediate or future prospects. Working costs will certainly have an important bearing on future results, and I am confident that the management will not rest until a decided improvement can be shown in this direction." From the Durban Roodepoort Deep comes an unusually cheerful account of things. Many troubles have been overcome, working costs reduced and a good year is now expected. Indeed, for a brief but comprehensive summary of the work, Mr. Wallers' own words cannot be improved upon. "To sum up the position, he said, "we hope to see an increased distribution to shareholders this year as compared with last year, barring any unforeseen accident, and at the same time steadily to liquidate the existing liability of which the temporary financing presents no difficulty. The development of your mine continues to reflect values which, as you will have noticed, are quite satisfactory, and I think the general position of the mine and plant entitles us to look for a successful year's work." These brief summaries will show that nothing but time and reasonable mining luck are needed to enable these great mines of the Eckstein group to realise their full possibilities.

SOME LEADING MINES OF THE CENTRAL MINING—RAND MINES GROUP.

THE CROWN MINES.

SATISFACTORY PROGRESS OF THE PLAN OF EXPANSION—SOUND JUDGMENT AND WIDE EXPERIENCE IN EVIDENCE—A WIDE MARGIN OF SAFETY IN THE RESERVES.

If Mr. Reyersbach's address to the shareholders of the Crown Deep on the 9th of April, 1909, furnished abundant justification, from the theoretical standpoint, for the great scheme of amalgamation which had been thought over and discussed by directors and engineers for so many months previously, and was then unfolded in all its detail and submitted to the consideration of shareholders, the results which have followed upon the practical development of the scheme still more abundantly strengthen the arguments used to recommend it. It is unnecessary to recapitulate the several excellent reasons which were adduced for this particular amalgamation, for a succession of proposals of a similar, if less attractive, kind have made everyone acquainted with the nature of those advantages which have been foretold as more or less certain to follow the fusion of comparatively small mining ventures. The experience gained with regard to some of these larger enterprises has not altogether popularised the idea of amalgamation perhaps, but nothing has happened, since the idea was first carried into effect upon the Rand, to refute the general statement that large scale mining, under proper conditions, is sound economy, and, within reasonable limits, admirably adapted to the low-grade ore bodies of the deeper levels of the Main Reef Series. What constitute proper conditions are primarily a due regard to fair grading, ample development, an abundant and efficient labour supply, and, last but not least, efficient management, and where one or other of these requirements are non-existent to a sufficient degree the best-planned scheme of large-scale mining is bound to prove a failure.

The Crown Mines amalgamation has not yet been tested by what may be called normal working results, for the preparations necessary to the carrying out of operations upon the lines proposed are still in progress, and it will take some months before the undertaking is able to get into anything like settled working conditions. It may fairly be judged, however, by the way in which provision has been made for the future, and by the agreement which is found between what has been anticipated and what has been accomplished. From this point of view there appears no reason to doubt the wisdom of the amalgamation, or to fear that it will fail in its object from want of skill or sound management.

A MODEL ENTERPRISE.

As a mining proposition, the Crown Mines probably represents one of the most carefully-planned undertakings of its kind in the world, both from the point of view of its development and from that of the working scheme which has been laid down for future operations. The payable ore reserves, as reported by the Consulting Engineer and General Manager at the end of last year, amounted to 10,124,072 tons, of which the value in recoverable gold is £14,816,326, or, roughly, 15 million pounds sterling. On the basis of only 14s. profit per ton, and leaving out of account another 1¼ million tons which can be mined but cannot yet be valued in the ordinary way, there is in sight a profit of over £6,000,000, or six times the nominal capital of the company, and nearly equal to 50 per cent. of the whole market valuation of the 1,880,212 issued 10s. shares, which are quoted to-day in the vicinity of £7. During last year the ore disclosed amounted to 4,712,353 tons of an average value of 7.3 dwts., and advance development is to be continued at as rapid a rate as possible, not so much for the purpose of increasing the reserves as to facilitate the economical handling and transport of ore. By way of comparison, it may be mentioned that the ore reserves at the Crown Mines, including the 1,250,000 tons, of which the greater portion will doubtless be payable, are equal to more than 80 per cent. of the total combined milling reserves of the East Rand Proprietary Mines and the Central Randfontein, while the average value is probably about 2s. per ton higher. The stamp capacity, on the other hand, is as 835 to 1,820, so that the margin of safety is easily in favour of the Crown Mines as against that of the other two companies combined on the basis of reserve alone. Market valuation can scarcely be taken into account in this connection at the moment, for in the case of both the East Rand Proprietary Mines and the Randfontein Central the share quotations is largely affected by circumstances other than the actual value of the ore in sight.

WORKING FACILITIES.

In the matter of a working plan, no less than in that of an advanced policy of development, are thought and wide experience abundantly evident at the Crown Mines. In the properties that comprised the units which were amalgamated there were, as Mr. Reyersbach pointed out, no less than fifteen main thoroughfares sunk between the surface and the reef series. Seven winding shafts were in use for hoisting ore at the time the scheme was carried through. When the preparatory work now in progress has been completed only two shafts will be used, connected at a vertical depth of 2,000 feet by means of a main roadway, 15 feet wide by 9 feet high, and served by electric haulage. The final length of this drive, between the eastern and western boundaries of the property will be nearly three miles, and to it will be brought all the reserves already in sight, and the reserves to be developed for a good many years to come. The other shafts will be used for ventilation, or, when necessary, for the ingress and egress of men and materials. The two shafts will have a combined hoisting and sorting capacity of 11,000 tons per day, or more than 30 per cent. greater than will be demanded by the plant when run at the full supply of 212,000 tons per month. Sufficient stope faces are in readiness for the larger scale of operations contemplated, and since the mine is about four years ahead of the mills, there is ample opportunity for keeping development well in advance, provided the labour supply continues satisfactory.

With regard to working costs, one has little hesitation in accepting Mr. Samuel Evans' recent assurances on the subject. In the last two years, as he explains, the charges under this head have been of an abnormal character, due entirely to the transition stage, and will, to a large extent, if not entirely, disappear after the completion of the enlargement programme. For instance, shaft maintenance has been a particularly expensive item, on which there should be considerable economy when only two well-equipped and up-to-date shafts are used instead of seven, some of which demand constant repair.

A WELL-INSPIRED WORKING PLAN.

The Crown Mines' plan of proposed operations has obviously been devised to give the fullest play to those favourable conditions which make all the difference between success and failure in the case of a big mining and milling policy. There are, moreover, the object lessons of other large amalgamations, where want of sound judgment and correct practice have led to disaster, and, prominently recorded as they are in the recent history of the Rand, it is scarcely to be doubted that they will serve as warnings which are little likely to be disregarded.

POSITION AND PROSPECTS OF THE COMPANY.

To Mr. Samuel Evans, the chairman and managing director of the Crown Mines, Ltd., we are indebted for a singularly lucid and concise marshalling of the stupendous array of facts and figures that go to make up the latest statement of the Central Rand amalgamation. It put the position of the property in the clearest possible terms, and it replies categorically to the criticisms levelled at the company. It forms a convincing vindication of the amalgamation of the Fordsburg-Langlaagte properties, and as a direct, straightforward and terse statement of the case it cannot fail to have an excellent effect in reassuring doubting Crown Mine shareholders, and all interested in Rand shares as well. Mr. Evans made his points so emphatic and analysed his own remarks so effectively that the work of the commentator is rendered easy. He did not waste time in repeating the figures for last year, which are now ancient history. Instead he plunged at once into the much-canvassed questions arising out of those figures. He admitted that the company had been subjected to a certain amount of criticism directed mainly to two points. In the first place, it had been stated that the promises made prior to the amalgamation have not been fulfilled; and, secondly, it had been urged that the shareholders, or at any rate some of them, would have done better had there been no amalgamation. By way of refutation, Mr. Evans compared the results obtained by the Crown Mines with the estimates framed and with the combined achievements of the separate companies prior to the amalgamation. To simplify the comparison, he dealt separately with ore reserves, capital expenditure, and monthly profits. With reference to the first, what is of supreme importance to shareholders of course is the total value of the recoverable gold contained in the payable reserves, and in that connection Mr. Evans gave the following instructive little table. It is based on an assumed extraction of 95 per cent.:—

Date. Dec. 31st.	PAYABLE ORE RESERVES. Tons.	Total value of recoverable gold contents.
1907	3,490,086	5,918,313
1908	4,104,006	6,462,270
1909	3,916,593	6,087,170
1910	6,282,719	9,639,260
1911	10,124,072	14,816,326
Estimates mentioned in Mr. Reyersbach's speech, 8/4/09	6,500,000	8,527,675
	7,000,000	9,103,650

"On the basis of only 14s. profit per ton milled, and leaving altogether out of account the 1,250,000 tons of ore which require no further development," said Mr. Evans, "we have in sight a profit of over £6,000,000, as compared with a profit of between £3,867,000 and £4,165,000 foreshadowed by Mr. Reyersbach. In regard to capital expenditure, Mr. Evans was able to repeat the explanation given last year, and to explain the very fair scheme whereby it is proposed to convert the bulk of the debt to the Central Mining and Rand Mines people into debentures. Relatively, of course, the debt is not a large one, and need not cause any anxiety when it is remembered that the company has nearly fifteen million pounds' worth of recoverable gold in its ore reserves, that it is in a position to mine at the rate of about 3,000,000 tons per annum, provided the requisite supply of labour and power is forthcoming. Turning to the question of monthly profits, Mr. Evans pointed out that the striking differences between last year and the forecasts made prior to the amalgamation are a shortage of tonnage of approximately 380,000, and higher grade and higher costs by 5s. 3.7d. and 3s. 6 4d. respectively. That is, the profits per ton last year were 1s. 9 3d. better than the estimate, so that had there been no loss in tonnage the total profit would have exceeded the anticipations. These facts suggest several questions which Mr. Evans anticipated and answered clearly and at length. These answers will be found in the report of his speech, and it seems to us that they dispose most effectually of all criticisms of the amalgamation. Mr Evans' self-imposed task included replies to the following:—(1) Why has the tonnage crushed been below the estimate? (2) What are the reasons for the costs last year exceeding the original forecast? (3) Is the mine not being overworked having regard to the grade called for by the payable ore reserves? (4) Would not shareholders, or at any rate some of them, have been better off had amalgamation not taken place? In the course of his reply he dwelt on the fact that before the fusion the labour supply was efficient, cheaper than at present, and up to the requirements of the companies. There has been a severe shortage since and the quality of the labour available has deteriorated, while its cost has increased. "I think I can safely say," added Mr. Evans, "that the inadequacy, inefficiency and higher expenses of the labour supply in the last two years have not only caused a serious loss of tonnage, but have also led to a general increase in the working costs."

THE CROWN MINES REDUCTION WORKS.

A THOROUGHLY MODERN AND WELL-ARRANGED MILL—THE TUBE MILL AND CYANIDE PLANT—TRANSPORT FACILITIES BETWEEN VARIOUS UNITS.

Some of the tangible results of the heavy capital expenditure incurred at the Crown Mines during the past twelve months or so are to be seen in the great 160-stamp mill and accessory reduction plant which has been running continuously since the 15th

February last. The official opening, however, took place as far back as the 28th October last, when milling operations on a preliminary scale actually began. To-day nearly the whole of the reduction plant may be said to be fairly under way, the old mill and cyanide plant having been closed down. It is perhaps incorrect to say that the old cyanide works have been put out of action, for although the main operations of cyaniding are no longer carried out there the vats are still being used for other purposes in connection with the new plant.

The 160-Stamp Mill.

The new 160-stamp mill is shown on other pages. It is situated a little to the south-west of the South Rand shaft, or No. 5 shaft as it is generally called, near the site of the old Crown Reef mill. In the picture is seen the embankment along which ore is conveyed by 45 ton ore hoppers from the crusher station. The mill itself is largely hidden from view, but it may be mentioned that the Butters plant is to the right and the cyanide plant to the left of the mill as it appears in the illustration. The stamps have a falling weight of 1,670 lbs., and each set of ten is driven by a separate motor. In accordance with present-day practice, there are no plates in the mill. The pulp from the mortar boxes is lifted by 12-inch Robeson-Davidson pumps for distribution to ten tube mills. There are six of these erected at present, the dimensions being 22ft. by 5ft. 6in. An interesting variation from the ordinary pulp thickening arrangement is in use, similar to a method adopted at the Modder B new mill. The overflow from the main cone flows to a second smaller one adjacent to it at the feed-end of the tube mill. The underflow from this secondary cone passes with that from the primary cone to the feed launder. The overflow runs down a launder to a third cone, also of comparatively small dimensions, situated near the discharge end of the tube mill. The underflow from this goes directly to the amalgamated plates, and the overflow joins the main discharge from the plates, which is lifted by a 12in. Robeson-Davidson pump to the set of secondary classifiers which return the oversize which requires regrinding. There are seven amalgamated plates to each tube mill. Originally they were designed with shaking gear attachments, but it was finally decided to keep the plates stationary. The finished pulp from the set of secondary classifiers just mentioned flows over to a further set of classifiers, which separate sand and slime for cyaniding. The sand is discharged by launders to five collecting tanks, each 50ft. by 10ft. 6in. fitted with Butters and Mein distributors and rim overflow. One of these tanks is shown in the foreground of the illustration which portrays the sands plant. The collected sand is discharged on to a pair of conveyor belts, which deliver in turn on to a cross belt, and the sand is thus carried to a main belt which leads to a double-balanced Blaisdell distributor, feeding right and left into adjacent tanks. In the picture the cross belt and main conveyor to the Blaisdell apparatus are clearly shown. The treatment tanks are twelve in number, the dimensions being 50ft. by 12ft. The treated sand is discharged into trucks, and so sent to the dump. The overflow slime from the classifiers flows to five 56ft. by 12ft. slime collectors, is withdrawn in charges for the Brown agitators, and finally passes to the Butters vacuum filter plant for the recovery of the gold solution. The slimes plant is to the left of the sands tanks in our picture, but does not appear in the illustration.

Extractor House.

There are 17 boxes in the extractor house, double and made of iron, similar to those at the City Deep, with side launders for cleaning-up purposes. In this building are the usual solution pumps and pumps for draining the tanks, two 8ft. by 10ft. acid lead-lined tubs with stirring gear, a Johnson filter press for cleaning up, Betty zinc lathe, tool sharpener, etc.

Slime Pump House.

Here are three 11in. Rees-Roturbo return water pumps for supplying the mill, two 7in. sludge pumps for handling slimes, one 5in. high-lift Sulzer, and one 5in. Tangye pump for dealing with solutions, and two 6in. low-lift Sulzer pumps for handling the solutions produced by the Butters plant. Each of these various pumps has a separate motor drive. A Belliss and Morcom air compressor is in use for supplying air to the Brown agitators and Butters tanks. Mention was made earlier in these notes of the later uses to which the old cyanide plant has been put. It may be explained that the four 40ft. by 10ft. upper collecting tanks have been converted into slime solution clarifiers, and the lower cement treatment tanks into sumps for storing solutions. The whole plant has been designed on the most modern lines, and in accordance with recognised methods of ore treatment. There is, in other words, nothing of an experimental or tentative kind in the work, and the whole is a worthy unit in the great scheme of gold winning which has been proposed for the Crown Mines when the preliminary operations now in progress above and below ground are completed. The works are connected by rail with the two crusher stations at the No. 5 and No. 7 shafts, which are each connected with the other, and also with the old mills. The ore hoisting sections and the recovery sections of the mine are thus linked up in such a way, that every facility is provided for the transport of the ore over the surface from and to any required point. In order to secure this end a considerable expenditure has been incurred in the laying of the main lines of railway, and it can scarcely be doubted that the expenditure will prove in the near future to have been fully justified.

The new mill, it may be added in conclusion, takes the place of the old Crown Reef mill section of the amalgamated crushing plant, which is, of course, still available for crushing purposes when required.

CITY DEEP, LIMITED.

A Great Mine with a Great Future—Results to Date no Criterion of Real Potentiality—The Mining Scheme—The Extensive and Modern Equipment Described.

Few mines on the Rand have attracted more attention than the City Deep. In the mid-nineties the Bezuidenville borehole did not, according to popular opinion of that time, augur any too hopefully for the future of the group of deep levels known as the City Deep, South City, Wolhuter Deep, South Wolhuter and Klipriversberg claims. For years these blocks lay dormant, but in 1905 the idea of fusion, which had no doubt been in the minds of their sponsors for a long time, took definite shape, and with the idea of amalgamation in view two seven-compartment shafts were started, and the exploitation of the property was commenced with a view to comprehensive working.

Early Development.

Reef was encountered in the No. 2 or western shaft in March, 1908, and in the No. 1 or eastern shaft in December, 1908. Early development quickly established the great potential value of the property. In his speech at the meeting held in March, 1909, the chairman of the company called attention to the remarkable persistency of the gold contents throughout the Main Reef Leader, the good values obtained from the No. 1 shaft, the improved grade of the City and Suburban in depth, and the regular distribution of the gold in the City Deep itself at the western shaft. He further stated: "The Main Reef Leader of the City Deep to-day not only shows a probable yield per ton which will place this company among the richest producers of the Rand, but with its average dip of about 38 degree promises to yield over 35,000 tons per claim, irrespective of Main Reef and South Reef bodies." Very possibly an exaggerated view of the profit-earning abilities—the immediate profit-earning abilities it would be more correct to say—was read into these remarks. They were wholly justified, as some study of the recent results secured by the mine should demonstrate, but it appears that too much has been expected of the property in the first year or two of its production.

Rumours and Realities.

It is difficult to understand whether this attitude has been the parent of the many sensational rumours that have been in circulation regarding the mine or not. Suffice it to say, however, that the City Deep has been the subject of many unfavourable reports—a few founded on reason, the majority on baseless rumour. To bring a proposition of the magnitude of the City Deep to the productive stage cannot be achieved without difficulty. Troubles are bound to be experienced, both above and below ground, and especially if labour is insufficient and inefficient must difficulties be expected. With regard to the reports current at one time as to the faulty features in plant construction, we will remark that, whatever constructional defects have had to be remedied in the past, the equipment is now running smoothly and satisfactorily, and is fully capable of securing high extraction at comparatively low cost, from sixty thousand to sixty-five thousand tons of ore per month were sufficient labour obtainable to produce such a tonnage. As to the underground position, criticism against the City Deep mine has mainly alleged an insufficient number of stope faces and exaggeration in estimates of ore reserves, also that waste rock is being crushed to show a spectacular tonnage factor. At the end of January there were, according to Mr. Tillard, the acting manager, 52 stope faces, of which 14 were in back stopes. Mr. Tillard, in his report, further stated: "With reference to the development, 46 drives, winzes and raises are being advanced, and work would be immediately commenced in 49 additional faces if there were sufficient native labour." It is true the number of faces is comparatively small, small at any rate for a mine of the crushing capacity of the City Deep, but it is clear that this is largely a matter of labour.

Effects of Labour Scarcity.

The consulting engineer, in his report, admits that a more conservative view has to be taken of the workable size of blocks developed above the upper level of the mine, and that this is the chief reason for a reduction in the ore reserves as compared with the preceding year. More ore was stoped than developed last year at the City Deep, and the pay limit has been slightly increased. Work last year was greatly hampered by labour shortage. That available was concentrated on increasing the output from the mine, to the detriment of development. A breakdown at the pumping plant towards the end of the year further hindered operations. But as against these adverse factors, it must be pointed out that ventilation has been much improved, and that, despite the decline in reserves, the tonnage blocked out to-day is well-nigh three years ahead of the full milling requirements, whilst the value at over eight dwts. is appreciably above the Witwatersrand average. We understand, too, that lately a considerable amount of additional development required to render the whole of the reserves available for stoping has been achieved, and that, furthermore, certain additions have been made to the ore reserves in new ground. As to the crushing of dump rock, 109,716 tons were crushed last year from this source, and a profit of just under £25,000 was derived therefrom. To-day something like 20 per cent. of the ore is being derived from the surface dump. This ore assays about four dwts. per ton.

A Vast Area: Lay-out of the Mine.

The mining area of the City Deep property is equivalent to 1,099 mining claims, including 13.5 claims in respect of mining rights under certain water-rights, bewaarplaatsen, etc., acquired from the Government. In the upper portion of the property the extent from boundary to boundary is 9,700 feet, and in the lower section, that is below the elbow that juts out from the Nourse Mines, 11,800 feet. The proposition is served by two shafts, the No. 2 (or western) being distant 3,500 feet from the western boundary, and the No. 1 (or eastern) 1,700 feet distant. The distance between the two safts is 4,400 feet. It will be evident from the foregoing that the property is of vast extent in so far as distance along the strike is concerned. As to the amount of reef available on the dip, it may be remarked that on a basis of 250 feet of backs, no less than 34 levels will in the course of time be opened up. The exploitation of this vast mine is at present proceeding in accordance with the policy of the majority of the larger Central Mining Corporation deep level areas. Thus the eighth level is being driven right through the property, and will be the first main haulage level in the mine. At lower depths other haulage levels will be driven, and the scheme of working will include the use of these levels as main ore thoroughfares served by mechanical

haulage. Ore will be gravitated down to them, and all tramming operations will be concentrated on and along these levels to main hoisting and loading stations. From the west or No. 2 shaft a crosscut is now being driven from a point 2,137 feet below the shaft collar to intersect the reef, about 310 feet south of the company's northern boundary. The total length of this crosscut is estimated to be 1,100 feet. This crosscut is being put in because the original scheme of exploiting the large area between the fifth level and the northern boundary by means of rises and back stoping was found to offer too many difficulties to ventilation and rapid progress. In this portion of the property the No. 5 is at present the top level, and the No. 9 the bottom. Above the seventh level there are, it is estimated, 1,400 feet of backs. The No. 1 or eastern shaft has been sunk 100 feet below the ninth level. It is calculated that reef will be encountered on the fourteenth level, and this will then become a further main haulage level.

Question of Ore Reserves.

The development of the mine to date, it will be gathered from the above, has scarcely in reality commenced. Nevertheless the payable ore reserves at the end of last year, including 136,922 tons contained in shaft pillars, were given at 2,078,805 tons of an average value of 8.1 dwts. per ton, of which 2,063,157 tons were on the Main Reef Leader. During 1911, 7,005 feet were driven on reef formation, of which 6,901 feet were on the Main Reef Leader. On the South Reef only 104 feet were driven, the value being 6.7 dwts. over 36 inches. As in the earlier development of the Village Deep, South Reef development to date has presumably been disappointing in this mine. It is particularly noticeable that, in comparison with the preceding year, there is a reduction of 335,759 tons in the payable reserve. This is attributed principally to the fact that in 1911 operations showed that owing to the difficulty of ventilating back stopes a more conservative view has been taken of the workable size of blocks developed above the upper level of the mine. The whole underground position of the property has been greatly hampered by insufficiency and inefficiency of native labour. The position in this regard has improved somewhat of late, and at the time of writing there are about 3,400 natives registered on the books of the company. This complement is still 1,600 or more below the full required complement of the ecompany on the basis of 65,000 tons a month crushing, with the plant is capable of treating.

The Reduction and Cyanide Plants.

The reduction and treatment plants are laid out on a scale of completeness and with a view to permanency for which it would be difficult to find a parallel in mining. In the light of the latest American practice, criticism might perhaps be directed against the extent of ground covered by the plant; but, if it lacks anything in concentration, it should be remembered that the whole equipment has been laid out with a view to expansion, that it has been evolved gradually, and that it has assimilated various new metallurgical and engineering ideas at different periods of design and construction work. The crushing and sorting operations are for the time being concentrated at the No. 2 shaft. In this steel station there are twelve Hadfield crushers, with picking belts and all arrangements for the rapid and economical rejection of waste. Ore is led into bins of a total capacity of 1,000 tons and is drawn off into 40-ton trucks (similar to those employed at Randfontein, Crown Mines and the Main Reef West), drawn by electric locomotives. The doors of the bin are opened and closed by throttles, operating compressed air cylinders, the pistons of which act directly on the bin doors, and open or shut them as required. A similar installation is employed at the Crown Mines new sorting plants, but at the City Deep property the 12 crushers are divided into sets of four, one conveyor belt delivering to each set. Reduction gear, supplied by the Power Plant Company, reduces the speed of the motors driving the belts from 475 to 7.9 revolutions per minute. The electric locomotives run up a trestle track and deliver into the mill bins, whence the ore is fed automatically into the 194-stamp battery. This is in point of capacity a 200-stamp mill, there being 190 ordinary Californian gravitation stamps of 2,000 lbs. weight, supplied by Fraser and Chalmers, and four Nissen gravity stamps (made by Head, Wrightson and Co.) of 2,245 lbs. weight, these being the equivalent of a further ten stamps. It may be recollected that the results of a series of tests carried out some time ago with these latter stamps gave a duty of 37.74 tons per stamp per 24 hours through a ⅜ in. mesh screen, the horse power absorbed being .14 per ton crushed. The stamps are electrically operated in sets of ten by motors running at 580 revolutions per minute, rated at 14 amperes, and developing a continuous horse-power factor of 50. Two meshes of screening are employed in the City Deep battery, "9" and "16," and the average stamp duty is about 14.5 tons per diem. The average crushing duty last year was 13.2 tons, and for the first two months of 1912 duties and stamps running have been:—

	Stamps Running.	Crushing Duty per Stamp per 24 Hours.
January	110	13.8
February	110	13.96

The mill pulp is elevated to the Caldecott and Bosqui cones for separation before entering the tube mills by Robinson-Davidson tailings pumps. Nine Allis-Chalmers tube mills, each of standard 22 feet 6 inches length, are installed, and it is likely that further extensions of milling capacity will largely be secured by adding more tube mills more probably than by installing additional stamps. Adjoining the tube mill station is the tube mill motor house. There are here nine motors, supplied by the A.E.G. Company (one to each tube mill), each motor being rated at 362 revolutions per minute, 274 amperes, and 100 continuous horse power. All the actual gold recovery operations are centralised under one roof. On the north side are the tube mill plates, 63 in number (seven to each tube mill), and of stationary type. On the south side are the 36 extractor boxes and the Johnson filter presses. The cyanide plant lies immediately to the south of the extractor house, and here, as in other portions of the plant, reinforced concrete has been used extensively. Some of the settling tanks, in fact, are of solid concrete structure. Sands for the sands treatment tanks are discharged by Blaisdell excavators. Pachuca vats are employed for agitating. The refining department comes under the same roof as the plates and extractor boxes. It is replete with all modern smelting devices, and the equipment here will shortly be enlarged by the addition of a blast furnace for dealing with by-products. Photographs accompanying this article give a general idea of the lay-out and design of the plant.

Finances, Life and General Outlook.

The accounts of the company for last year show a profit of £90,936. Adding to this the balance of working capital brought forward from 1910 (£61,813), a total of £152,749 is arrived at. This sum has been appropriated as follows:—Expended on capital account, £117,981; Government profits tax, £5,430; balance carried to balance sheet, £29,738.

The life of the City Deep is obviously a long one. It has been estimated that the ore contents of the Main Reef Leader alone will give from 30,000 to 35,000 tons per claim on an average dip of 38 degrees, and a stoping width of about 4 feet 6 inches. This estimate ignores South Reef and Main Reef, and there are distinct possibilities as to the use of ore from one at any rate of these ore bodies in the future. Accepting a gross tonnage of 35,000 tons per claim, and allowing for faults and sorting to the extent of 25 per cent., the tonnage existent in the claims would last the present full battery for between thirty and forty years. The results secured to date by this company, with its vast area of mining ground and highly modern plant, must not be regarded as affording a criterion of the results likely to be secured in the near future. We believe that at an early date the City Deep will justify the most sanguine expectations that have been made concerning it.

VILLAGE DEEP, LIMITED.

Improved Results Secured—Reef Dips at a High Angle in the Lowest Workings—Activity in the Turf Mines Section—The Promise of the South Reef.

There are several features of interest to be observed in connection with the Village Deep, Ltd. The company is doing much better to-day than it has ever done previously in so far as the all-important consideration of profit is concerned. Then again development work is disclosing encouraging values and widths, a larger percentage of South Reef, which for long proved a disappointing ore body, is being sent to the mill, and furthermore the ore reserves have been augmented. In addition, developments of a very important nature are taking place in the deeper portion of the company's claims, that is to say, in the Turf Mines section of the property. The total mining area of the Village Deep, Ltd., now amounts to 535 claims, including the Turf Mines property lying immediately to the south of the original Village Deep block. To exploit this deep section a large seven-compartment shaft has been sunk to a depth of 4,106 feet, and this intersected the South Reef at a depth of 3,815 feet, in April, 1909. The 18th level is situated at a depth of 4,034 feet from the surface, and the inclines from the two main vertical shafts of the original Village Deep section have been carried down to the 16th level. The 16th is to be a main haulage level, and preparations are well advanced for the installation of mechanical haulage there.

Concentration of Work in Depth.

It may here be remarked that development of the Main Reef Leader in the Village Deep has been completed down to the 13th level, and although large areas of South Reef remain to be opened up the company will have to look to the large southern areas until recently incorporated in the Turf Mines, Ltd., for future development. Accordingly ore and water will be gradually concentrated at the Turf Mines vertical, and will be hauled and pumped up through this shaft. Large quantities of water from the upper levels of the property are now being allowed to gravitate to the pumping plant at the 18th level, which consist of an efficient installation of Gould 3-throw electric pumps. Exploitation of the deeper areas in the Turf Mines will be effected by means of the main incline and by two development inclines which, for want of a better description may be defined as "glorified winzes." These development inclines will be carried down in the reef as far as possible. The east incline starts from the 17th level, and the west incline from the 18th. It is proposed to open up succeeding levels at distances of 250 feet apart, and to adopt the "cone" system of mining as opposed to the "inverted cone" method. The east development incline will accordingly be carried down to the 20th level, and at this point a main mechanical haulage track similar to that at the 16th level, will be adopted. It may here be mentioned that a small amount of development rock is being sent to the mill from the Turf Mines section, and that in this area drives are being put in underneath the Main Reef Leader instead of on it, in order to obtain a greater security of ground.

An Important Shaft.

The main incline shaft of the Turf Mines, which is 38 feet 6 inches wide, starts just above the 17th level. At present a temporary sinking engine is being utilised; the main electric winder will be installed above and behind this. In order further to facilitate the concentration of work at the bottom of the Turf Mines vertical a large chamber has been cut at the 18th level, and has been almost connected up with the main incline. This is to serve as a main marshalling station for men and tools, etc., and will in fact be an underground reprodnction of the collar of an incline starting from outcrop.

Above the 18th level an ore bin chamber of 2,000 tons capacity has been cut. Having regard to the large stretch of dip ground opened by the company it not surprising to learn that the exploitation of ground lying to the south of the bottom of the development inclines—that is to say, below the 21st level—has already been considered. In the course of the next few years work will be proceeding in the Turf Mines section of the Village Deep, Ltd., at a depth of 7,000 feet or more. Modern underground practice with stage winders seems to have no really

important obstacles to contend with. In the bottom workings of the Turf Mines the temperature is remarkably mild, and though the small Sirocco fan in this section has not yet been started, the air is by no means unpleasant. Of course, installation of Sirocco fan in the Village Deep (where it was badly needed) has greatly improved ventilation, and there are no reasons for doubting that with the assistance of artificial ventilation, men will be able to labour in the deepest section of the Turf Mines and suffer but little discomfort.

The "Dip" Factor.

Should the angle of dip apparent in the present lowest workings of the Turf Mines be maintained, the most southerly section of the Turf Mines will only be attacked at an enormous depth. It is a highly important and seemingly little recognised fact that in the lowest workings of the Turf Mines (and thus in the deepest section of the Central Witwatersrand) the formation has steepened considerably. The main incline from the 17th level has been commenced at a dip of 41 degrees, and in the lowest workings in the mine the formation inclines at an angle approximating to 40 degrees. These disclosures are of the very foremost importance, not only to the Village Deep Company, but to the Central Rand generally. The high angle of inclination may of course be due to proximity to some large stratigraphical disturbance, which has yet to be exposed, but up to the present signs of such disturbance are lacking. It is true that on the 18th level a dyke may be seen lying between the Main Reef Leader and Main Reef, but this interbedded body has been determined to be conformable over a fair stretch of development, and exerts no disturbing influence on the strata. The high dip evident in the lower workings of the Turf Mines will, of course, have an important tendency towards reduction of lashing costs, and it also means an increased tonnage per claim.

The Ore Reserves.

In regard to the Village Deep as a whole a large amount of development has been achieved, and the ore reserves at the end of 1911 amounted to approximately 2,000,000 tons, of which 485,000 tons were in respect of South Reef. The average value is just over six dwts. per ton, and the stope widths are placed at 62 inches for the Main Reef Leader and 50 inches for the South Reef. As compared with the position obtaining at the end of 1910, it may be remarked that widths and values are about the same, but a fair increase has been attained in tonnage. It must be borne in mind, too, that a considerable tonnage has been developed, but not valued, so that in reality the Village Deep is to-day in a much better position as regards ore reserves than twelve months ago. In regard to mining it is important to note that 15 per cent. of the ore drawn last year came from the South Reef, as compared with 7½ per cent. in the preceding twelve months. The fact that better developments are now being obtained on this body in the western section is of great importance. In other parts of the mine this reef is practically undeveloped. South Reef ore reserves at the end of 1911 were getting on for double those recorded at the end of 1910. The full labour complement of the Village Deep based on all hammer boy policy is 6,000, but not 4,000 are at present registered in the books of the company. Full advantage has accordingly been taken of machine drilling, and 90 per cent. of the ore broken in the mine to-day is derived from this source.

Much Improved Returns.

Although the Village Deep Gold Mining Company has recorded a progressive increase in profits since the commencement of reduction operations, it is only during the past few months that the mine has given a real indication of its profit-earning possibilities. In the first year of productivity, twelve months ending December, 1905, the Village Deep earned a profit of £43,788 from 159,687 tons milled. In the following twelve months ore crushed and profits earned were almost doubled. During the year ending December, 1907, the company crushed 281,380 tons, and earned £76,651.

Results secured during the next three years were:—

	Tons Milled.	Working Profit.	Per ton Milled.
1908	352,100	£128,709	7s. 3.731d.
1909	444,800	146,634	6s. 7.119d.
1910	507,800	154,067	6s. 0.816d.
1911	569,500	225,779	9s. 1d.

The profit per ton earned in respect of the 1911 operations was 8s., as compared with 6s. 1d. in 1910, and as is shown in the above tabulated statement, the company crushed over 60,000 tons more last year than in 1910, and secured a profit greater by over £70,000.

The Reduction and Treatment Plant.

The Village Deep possesses an efficient and modern reduction and treatment plant, consisting of 180 stamps and 6 tube mills. These were employed throughout last year, and they crushed 569,500 tons, or 61,700 tons more than 1910.

MODDERFONTEIN "B" GOLD MINES.

Interesting Underground Work—Novel Development Policy—Condition of the Mine—A Model Plant—The Company's Prospects.

Seventeen years have elapsed since the first property of what to-day is known as Modderfontein "B" Gold Mines, Ltd., was registered in South Africa as Modderfontein Extension, Ltd. Crushing operations were commenced on the property at the end of September last. It may seem that an unduly long period has intervened between the dates of flotation and initial milling; but, apart from the general disorganisation of the mining industry during three years of war and from the resultant political and industrial chaos which necessitated the concentration of money, talent and labour on the more central portions of the Rand, there are certain peculiar circumstances connected with the Modder "B" Company which explain its absence from the list of producing mines until just recently.

Reef Characteristics.

Although the reef in no part of the property lies at a greater depth than 1,500 feet, the banket itself (with the exception of one or two small patches) is overlaid with secondary measures of Karroo age. The Modder "B" is not, therefore, an outcrop proposition, although it will never have to operate at a great depth. The outstanding feature of the property is that the reef in this section of the Rand is abnormally flat—the average dip being in the neighbourhood of 14 degrees. The distance of the property from the central section of the fields, the unsatisfactory labour position and difficulty experienced in raising fresh funds during certain periods of Modder Extension's existence further tended to defer the date of milling. The reef in the property is comparatively thin, the average width as disclosed by development to date being in the neighbourhood of 13 inches.

The Company's History in Brief.

Before proceeding further with this article, it will be advisable to recapitulate the outstanding features in the company's history. Some years ago indecisive prospecting work was carried out on the Modderfontein Extension's area, these spasmodic operations extending over a considerable period. In 1905 two shafts were put down by Mr. C. B. Saner, but in 1906 the company's funds were exhausted and all operations stopped. The real history of this important section of the further East Rand may be said to date from 1908, in which year the concern was reconstructed, a large amount of working capital was provided, the Modderfontein Extension and Modderfontein Restante claims were absorbed, and the Modder "B" Gold Mines, with an issued capital of £700,000 and a mining area equivalent to 1,467 claims (1,400 reef-bearing) resulted. For this large property possessed of 13,000 feet of reef strike a decisive policy was initiated, largely, no doubt, because of the very encouraging results secured in the New Modderfontein mine. With a view to defining the development programme, boreholes were sunk, old prospecting shafts re-opened and the sectional exploitation of the claims was prosecuted by means of a series of shafts. The numerous shafts sunk on the property have been of great value in the preliminary development of the mine, and they will also, of course, play an important part in the ventilation of the underground workings, but as hauling ways they will be of little account, as the main shaft is designed to deal with all ore, men and tools.

A Novel Development Scheme.

The policy adopted for the opening up of this mine, which has been successfully carried out under the superintendence of Mr. H. Stuart Martin, the company's consulting engineer, is different in several essential particulars to general mining practice on these fields. The main features to be taken cognisance of at the Modder "B" are:—(1) The main central shaft, which is designed to handle all the requirements for the 80 stamp mill and such extensions to this mill as may in future be carried out. This shaft has five compartments, and all ore drawn from the different points in the mine will be concentrated at the main shaft ore bins. (2) Development of large blocks of ground, the blocks opened up being 800 feet by 1,000 feet in size. (3) The driving of a main haulage level throughout the mine. A closer examination of these three important details in the Modder "B" Company's property is now called for. The main central shaft has been sunk to a depth of 780 feet. It is equipped with a substantial steel headgear and 1,100 horse-power electric hoist, fitted with single drum—a type of engine which, we believe, is now finding great favour in the large British coal and iron mining districts.

Large Blocks of Ground Exploited.

The policy of opening up large blocks of ground was decided on after a very full and careful study of local conditions, and the development of adjacent properties. As a result of this it was anticipated that values might be erratic, and it was accordingly deemed inadvisable to open up this section in small blocks at the risk of spending a considerable portion of funds in developing unprofitable ground. The correctness of this view was demonstrated by meeting with a large area of very poor ground in the immediate neighbourhood of the central shaft, but a bold policy was adhered to, drives were extended and the ore reserve position of the company, according to Mr Schumacher, who presided at the annual meeting in March, 1911, was as follows at the end of 1909:—"The large total of 2,788,000 tons of reef has been blocked out, of an average value of 7 dwts. over an estimated stoping width of 48 inches. This represents the payable tonnage exposed, though some secondary devedopment work will be necessary before the whole of it will be available for stoping. There are, in addition, a little over 600,000 tons of an estimated average value of 3.4 dwts. over a stoping width of 48 inches, which are, at present, not classed as payable reserves. The ore that has been exposed is in blocks of large size, measuring approximately 800 feet by 1,000 feet, and it is most satisfactory to be able to record that, so far, comparatively little unpayable ore has been encountered. With these large blocks it is not possible to determine the grade of the ore as accurately as would be the case if the management had adhered to the more conservative method of keeping the levels only 200 or 300 feet apart, but there is reason to believe that the estimates that we have framed on the basis of the information at our disposal will prove approximately correct. The justification for having worked on the big lines recommended by Mr. Stuart Martin, our consulting engineer, will lie in the results achieved. So far we point to the extensive and cheap work we have done. The payable ore reserves of the Modderfontein "B" stood, at the end of last year, at 2,788,000 tons, as I have already stated, and there were then by lineal measurement of both sides of the winze connections 11,000 feet of stope face ready for attack. To-day we have approximately 3,000,000 payable tons of ore blocked out; and this figure is, if we exclude the Witwatersrand area, equal to well over half of the total payable development of all the other gold mines in South Africa and Rhodesia put together."

Further Underground Features.

The main haulage level is at a vertical depth of about 650 feet, and is the second level in the mine. The greater part of the development work carried out in the Modder "B" to date has been in the western section of the property—that is adjacent to the New Modderfontein Company's ground. It may be recalled that in the eastern portion of that property operations from No. 12 shaft disclosed good ground in depth, and apparently the Modder "B" operations have indicated an extension of this zone

in an easterly direction. The main haulage level has been driven 4,500 feet west of the main central shaft, and to within about 2,000 feet of the western boundary. East of the main shaft the drive has progressed about 1,500 feet. This main haulage drive is 10 feet by 8 feet where the track is single, and 16 feet advanced at an average rate of 309 feet per month, Ingersoll drills being employed. This main haulage level has obviated the sinking of two large vertical shafts east and west, and has therefore resulted in a large capital saving to the company. As against this, it has been readily appreciated that, on account of the long distance ore has to be trammed underground, transportation charges will be high. With a view to facilitating matters in this direction, mechanical and animal transport has been adopted. Commodious stables have been installed to the west of the main shaft, and a number of ponies are employed on hauling the trucks. In addition, rope haulage has been installed. As further development of the mine proceeds and lower levels are opened up it may be necessary to establish another main haulage road below the second level. But this is a consideration of the future, the existing road should suffice for some time to come.

A Most Modern Plant.

The equipment of the Modder "B" mine is modern in every particular, in fact no expense appears to have been spared to render it the last word in Rand mining and metallurgy. On visiting the property one is struck by the large area over which the plant extends. Clearly it has been laid out with a view to future expansion. The present milling installation consists of 80 stamps, each of 1,650 lbs. weight, and five tube mills. Provision has been made for the erection of a further 80 heads at the back of the existing mill, provided the future development of the mine warrants this, and still further expansion can be effected. The whole plant was originally designed on a possible and ultimate 120,000 tons per month basis, and this was subsequently divided into four units. Of these but one is at present erected and in operation. Extensions will, of course, be contingent on the manner in which the mine opens up. There are no plates in the battery, all the operations of actual recovery being concentrated in the cyanide works extractor house, where the stationary amalgamated plates are located. The treatment plant includes such modern-day appliances and methods as classification cones, zinc dust precipitation, Merrill presses, Butters' filters and Brown agitators. The sorting arrangements are very complete, and include a return belt "picking" plant— the belt, by the way, shows remarkable signs of heavy wear and tear for the short period this installation has been at work. A certain amount of sorting is carried out underground, and approximately a further 11 per cent. is eliminated at surface. The surface plant includes a 265-drill Bellis and Morcom electrically operated air compressor.

In view of the risk incurred in the estimation of values and control of the average yield by reason of the adoption of the policy of development in vogue at the mine, the building up of a substantial reserve, whereby the output may be regulated, was deemed advisable. Such a device was not, however, in keeping with the views of large European shareholders, as expressed at a meeting held the other day in London in connection with the East Rand, and reserves were abolished. Having regard to the peculiar circumstances of Modderfontein "B" Mines, the gold reserve policy, if it is to be tolerated in any form whatever and at any mine, might be pursued by the company under consideration. Mr. Stuart Martin, it may be recalled, wrote in his last annual report: "Samples taken on the periphery of these large blocks of ore only represent the average value in an approximate degree, and therefore allowances have been made when valuing the ore reserves. It is probable that some blocks we class as payable may contain patches of unpayable ore, a great part of which may necessarily have to be mined; and, on the other hand, secondary development, to further prove blocks that show poor values round the periphery, may have to be done at a later date in order not to miss patches of payable ore."

"Life" and General Prospects.

It is a dangerous practice to hazard calculations as to the "life" of Rand mines, and especially as to the life of a large property such as the Modderfontein "B," where, on account of the peculiar method of development adopted the average gold contents of the reef are difficult to calculate, and where because of the large ore contents of the proposition any material increase or decrease in working expenditure may transfer millions of tons of ore from one side of the profitable and unprofitable ore reserve ledger to the other. It seems, however, fairly safe to estimate that the company will have 1,100 net reef claims (after making a liberal allowance for faulted ground). By pursuing the system of packing with waste, few pillars may be required unless special precautionary measures are adopted to ensure the safe condition of the mine underground (measures which we must confess appear to us necessary). Assuming an average dip of 14 degrees and a stoping width of 48 inches, the average ore contents may be estimated at 22,000 tons per claim. On 1,100 claims this represents a total tonnage of 24,200,000 tons, and assuming all this to be of profitable value the "life" of the mine on its present milling basis would approximate to 67 years. Unless, however, the proposition becomes a great disappointment (and there are no reasons to justify such an anticipation at present) one can estimate with confidence that the reduction and treatment plants will be increased to at least double their present capacity (about 360,000 tons per annum) with a consequent diminution in "life." Provided the mine continues to open up satisfactorily, one can calculate on an even greater plant than that indicated above being at work before many years have elapsed, and there will be a further increase in the rate of exhaustion. Of the dividend earning possibilities of the mine in so far as any period which exceeds the next few years are concerned, we prefer to say nothing at this juncture. The mine unquestionably appears to be opening up well at present, and the scheme of development adopted has many points in its favour. The Modder "B" is, however, somewhat of an unusual undertaking on the Witwatersrand, and but a fraction of the mining area—merely a portion of the western section—has to this date been exploited. We shall await the future results of the company and the complete justification of the policy of development inaugurated there with a large amount of interest and a not inconsiderable measure of confidence.

THE ROBINSON G.M. CO., LTD.

If the test of a mine's greatness be the value of its output and the amount of money it distributes amongst its shareholders, the Robinson G.M. Co. is assuredly one of the greatest mines, even in these days of big amalgamations and vast reduction plants.



History of the Company in Figures.

The Robinson commenced crushing in January, 1888—more than 24 years ago. Between that date and up to the end of last year, six and a half million tons had been mined, and over five and a third million tons had been milled. The total gold declared amounted to 3,814,771 ozs., or 14.145 dwts. per ton, the total working revenue being £16,039,831, or 59s. 6d. per ton. Of this, working expenditure absorbed 5,415,164, or an average of 20s. 1d. per ton, leaving profit of £10,624,668, or 39s. 5d. per ton. The dividends declared to date amount to over nine millions sterling. These figures are stupendous. The whole history of the Robinson is in fact a gilded tale of almost unexampled prosperity. In the first year of crushing only 10 stamps were at work, and all of the 7,486 tons mined were put through the mill. These yielded no less than £91,098, or £12 3s. 4d. per ton. The working expenditure in those days would give the modern Rand mine manager a most distressing nightmare. It was no less than 57s. 10d., but even with costs at nearly £3 the Robinson declared a working profit of £9 5s. 6d. per ton, or £69,438 in the aggregate. In the next year—1889—from 10 to 40 stamps were employed, and 31,472 tons were crushed for a yield of over a quarter of a million and a profit of £192,766. By 1890 the yield per ton had dropped to a little over £5; in the next year the rate of recovery was 92s. 3d., and the year after not much more than an ounce. But in 1893 over £5 per ton was again recovered, and by that date working costs had dropped to 35s. 7d. It is noteworthy that not until 1897 was any waste rock sorted out. Previous to that year all the ore mined was sent to the battery. For a few months preceding the outbreak of the Boer war the Robinson was recovering 75s. 10d. per ton, and the profit earned for the January 1st to October 30th period of 1899 was £438,200. During and since the war the Robinson has operated from 56 stamps in 1901 to 250 stamps and 6 tube mills during last year. After the resumption of crushing, large and increasing profits were piled up, and in 1908 the company attained probably to the zenith of its fame and achievement, by declaring over one million pounds sterling in profit. In that year workingexpenses were at the rate of 12s. 7d. per ton, and the Robinson's expenditure was held up to the Rand as a moral and example of what working expenditure should be. Latterly the fetish of working costs has been relegated somewhat to the shelf of false policy. The working costs for last year came to 14s. 7.5d. as compared with 12s. 2.4d. in the preceding year. The amount of ore milled in 1910 was 638,900 tons, and in last year 592,700 tons. This reduced tonnage brought down the profit from £936,756 to £911,308, despite an advance of 4s. per ton in the grade.

The Life Factor.

Such, in brief, is the statistical history of this company. Recently a change in the management of this mine has taken place, Mr. Palmer Carter, who has for the past nine years managed the Ferreira, taking over the reins of office from Mr. Paul Selby, who has gone to the Geldenhuis Deep. Mr. Carter has entered upon the management of the Robinson in what may be described as its declining years. Nevertheless there is a "lot of life" remaining in this old property. It may be recalled that at the meeting held in March, 1908, the Chairman stated that "As far as we are able to judge the mill tonnage remaining in the mine on the stoping widths at present assumed, after allowing for sorting, is about equal to the tonnage already milled (3,711,134 tons), yet shareholders must be prepared to amortize the investment in about 7¼ years at the working costs of to-day. We can also contemplate the working of a considerable portion of the Main Reef which stands practically untouched in your property, and which may be expected to yield some profit after the richer areas have been extracted." The Robinson is in an advanced state of development, and comparatively little expenditure will have to be contracted under this head in the future, especially in regard to Main Reef blocks. The experience gained at the Robinson seems to point to an average extraction per claim of between 50,000 and 60,000 tons for the two richer reefs—Main Reef Leader and South Reef. How long the quantity of rich ore will last depends largely, of course, on the extent of its admixture with the low grade Main Reef body. Last year 33 per cent. of the ore stoped came from Main Reef blocks, 27 per cent. from the Leader, and 40 per cent. South Reef. Thus one-third was from what may be described as the lower grade zone, and two-thirds from the richer areas.

Main Reef Development.

The payable ore reserves on Leader and South Reef at the end of 1911 were estimated at 1,526,661 tons, whilst it was estimated that there were some 1,307,133 tons in the mine of payable and available Main Reef. A highly important statement on a matter which must have a marked influence on the life of the mine was made by Mr. Paul Selby in his report for last year. Mr. Selby remarked: "I feel that the subject of ore reserves cannot be passed without calling attention to the large discrepancy of 895,304 tons between the payable Main Reef tonnage as shown last year and that available at present. Of this difference, 148,593 tons are accounted for by the fact that more Main Reef was mined than developed during the year, thus leaving a difference of 746,711 tons, the bulk of which can be accounted for under the following headings:—Blocks which were considered payable last year but which have proved to be unpayable as stoping progressed; loss due to caving, and ore transferred from the payable to unpayable reserves, due to the higher pay limit consequent upon higher working costs. In considering the Main Reef reserves, it must be borne in mind that further losses of this reef, due to caving, are likely to occur." It is thus evident that one is not justified in anticipating that the Robinson will terminate its life in pursuance of a low grade policy for such a lengthy period as might have been estimated at the end of the preceding year. In fact the extent of Main Reef available seems to be a somewhat problematical factor. Taking last year's development returns we find that of the 90,668 Main Reef tons developed 44,048, or nearly one-half, was unpayable. An examination of the latest reports does not therefore make one particularly hopeful as to the part which the Main Reef is to play in the last few acts of what has been a drama of almost unparalleled magnificence in mining. But at the same time it must not be supposed that the Robinson is as yet on its "last legs." Indeed, the mine is assured of a prominent place in the output for some time to come, and if the Main Reef proves disappointing it is just as likely that other sections of the property will rise to the occasion, like the majority of Witwatersrand mines have done, and will substantially exceed the expectations of to-day.

ÉYE VIEW OF THE CROWN MINES





JOHANNESBURG CONSOLIDATED INVESTMENT COMPANY, LTD., JOHANNESBURG AND LONDON.

(Registered in the Transvaal.)

Authorised Capital, in £1 shares £4,500,000
£3,950,000 issued.

This Company holds a large number of shares in mining and other companies, also estate property in Johannesburg and London, mining properties in the Transvaal, interests in Delagoa Bay, etc.

DIRECTORS.

S. B. Joel, *Chairman*.

J. Joel. J. Friedlander.
Charles Marx. Sir R. B. Llewelyn, K.C.M.G.
A. R. Stephenson. H. A. Rogers.
Sir John Purcell, K.C.B. G. Imroth.
Isaac Lewis. J. Emrys Evans, C.M.G.. J. Munro.

MANAGING DIRECTOR IN SOUTH AFRICA.
G. Imroth.

LONDON MANAGER.
W. J. Benson.

JOHANNESBURG SECRETARY.
W. H. Mardall.

LONDON SECRETARY.
Thos. Honey.

JOHANNESBURG OFFICES.
Consolidated Building.

LONDON OFFICES.
10 and 11, Austin Friars.

CONSULTING ENGINEER.
Professor J. G. Lawn.

The last balance-sheet published (for the year ended 30th June, 1912) reflects total assets £5,119,000, of which amount £1,000,000 may be regarded as absolutely liquid, consisting of loans at short call, dividends accrued, and cash in hand. The total liabilities to the public amounted to only £557,000. The profit for the year ended 30th June, 1912, amounted to £207,000; making with the amount brought forward from the previous year £362,000. Dividend of five per cent. declared June 18th, to be paid September 27th; balance carried forward to next year, £165,000.

The Johannesburg Consolidated Investment Company, Limited, has a large holding in what are known as the

"BARNATO GROUP,"

comprising the following:—

Name of Company.	Issued Capital.
African Hotels Company, Limited...	£60,000
Barrett's Rietfontein Syndicate, Ltd.	£22,500
Central Commercial Buildings, Company, Ltd.... ...	£20,000
Consolidated Langlaagte Mines, Ltd.	£732,679
Delagoa Bay Lands Syndicate, Ltd.	£60,000
Ginsberg Gold Mining Company, Ltd.	£210,000
Glencairn Main Reef G.M. Company, Ltd.	£550,000
Gov. Gold Mining Areas (Modderfontein) Consolidated, Limited	£1,400,000
L.M. Syndicate, Ltd.	£26,000
New Heidelberg Roodepoort G.M. Co., Ltd.	£160,000
New Primrose Gold Mining Company, Ltd.	£325,000
New Rietfontein Estate Gold Mines, Ltd.	£610,084
New Spes Bona Gold Mining Company, Ltd.	£150,140
New Unified Main Reef Gold Mining Co., Ltd. ...	£250,000
Randfontein Deep, Limited...	£667,889
Quest Gold Mining and Developing Co., Ltd.	£150,000
Van Ryn Deep, Ltd....	£1,196,892
Widenham Township, Ltd.	£12,500
Witwatersrand Gold Mining Company, Ltd.	£425,000

PROGRESS AT "BARNATO" MINES.

STEADY INCREASES IN PROFIT—THE OUTLOOK AT NEW RIETFONTEIN, GLENCAIRN, AND MODDERFONTEIN.

Mr. J. Munro was able to speak of a year of steady progress and good work well done at the recent annual meetings of subsidiaries of the Johannesburg Consolidated Investment Company. The "J.C.I.," or as it is more generally spoken of, the Barnato group, has practically no interest on the Western Witwatersrand. With the exception of the Randfontein Deep, the activity of the company centres in the Central Rand, the Germiston area and the "farther East Rand," and in each of these spheres the year 1911 was productive of results on which the management are to be congratulated. Probably no other group on the Witwatersrand has carried on operations in such an even and one might almost say uneventful manner as the Johannesburg Consolidated Investment Company. A conservative attitude in regard to new mechanical, electrical and metallurgical devices has been pursued throughout the history of the corporation, although it must readily be admitted that, when satisfied, the Barnato management always gives material evidence of appreciation of any innovation—witness, for instance, the new plant of the Consolidated Langlaagte Mines, where more tube mills are being installed than at any other battery of similar size on the Rand. Then, again, Barnatos have not brought any new producer into the arena of industry for years past. The Van Ryn Deep will shortly become productive, and at a later date the Government Areas on Modderfontein; but in 1911, as in previous years, the parental company earned its revenues from the old outcrop mines in the neighbourhood of Germiston and Langlaagte. The New Primrose has been a mainstay of the Company since first the properties of the Rand began to group themselves and seek financial aid and technical administration under the sheltering wings of the various groups. It is more than gratifying to find that not only did this company earn the very substantial profit of £217,658 from 281,648 tons milled—which compares with £210,279 from 257,168 tons in 1910, but also that the prospects of an increased life are very good. In the words of the Chairman, "the further the reinvestigation of the older parts of the mine is proceeded with the more it becomes apparent that large quantities of ore were left undisturbed at the period when the mine was first worked." At the Ginsberg the ore reserves at 367,646 tons of 6.8 dwts. value show an increase in both quantity and quality, as compared with last year. The profit earned amounted to £59,344, which is nearly £11,000 higher than that earned during 1910. Here, too, there is every indication that the period of productivity will substantially exceed the most sanguine estimates of previous years. "On the whole the mine looks very promising at the present time," remarked Mr. Munro. The Glencairn Main Reef's profit of £29,035 is slightly higher than that announced in respect of the 1910 operations, but the ore in reserve 925,000 tons less, and low average assay value of 3.5 dwts.—is 195,000 tons less, and the estimated recoverable value is slightly lower. It appears that several blocks of reef-bearing ground have been found to be of lower grade than anticipated, and accordingly have been eliminated from estimates. Although the margin of profits at this mine is very low, Mr. Munro was able to tell shareholders that "the company should continue to pay small dividends for some years to come." At the "Knights" (or Witwatersrand G.M. Company) profits are "down" £46,000 as a result of a decrease in the yield of 1s. 6d. and increase in working costs of 7d. per ton.. Since the conclusion of the year, profits have largely increased, the profit for April being as high as £18,581, so that it is reasonable to expect a much improved aggregate for the current year. These results have been accomplished by mining ore of a grade more in keeping with the average grade of the mine. In consequence current expenses have risen, but, as the Chairman remarked, "low working costs are not always synonymous with the best economic results." The ore reserves at a million and a quarter tons are much the same as in the preceding year. The somewhat erratic New Rietfontein Estate is in a better position as regards ore reserves, and there are now tonnages in sight equal to two years' milling, whilst, in addition, a large tonnage is still available from reclamation work. The working profit was £39,349, as contrasted with £15,626 in 1910. Turning now to the two West-Central Rand producers, the Consolidated Langlaagte stands out prominently as a concern which will substantially advance the productive prestige of the group in the immediate future. Here the profit earned was £84,667—slightly in excess of the previous year's return. This was earned from the outcrop mine, in which the ore reserves at the end of the year stood at almost 400,000 tons. In the southern section 1,400,000 tons stood developed at the end of April. The new equipment, which is described in detail in this issue is ready to commence crushing. The New Unified represents the most westerly of the Barnato group of producers. The profit at £51,987 shows the considerable improvement of £18,870 over the preceding year owing to increased grade and lower costs. The mine is looking well, particularly in the bottom levels, and the ore reserves—288,343 tons of an estimated value of 6.73 dwts.—are slightly in excess of last year's tonnage. On

the further East Rand the Johannesburg Consolidated Investmont Company possesses two great prospective producers in tho Van Ryn Deep and the Government Areas on Modderfontoin. In twelve months' time the reduction plant of tho former company, of 40,000 tons per month capacity, is expected to start crushing. The tonnage of ore developed at the end of the year was 603,716 tons of 7.17 dwts. value. Finances have been satisfactorily arranged, and the outlook is distinctly promising. As Mr. Dalrymple, who seconded the adoption of the report, remarked, "the company should inaugurate its career in as auspicious a manner as its neighbour the Brakpan Mines." Mr. Gustav Imroth reminded shareholders at the Government Areas meeting that the area of the mine was an enormous one, covering over 2,600 claims, and that the wholo of the capital of the company of £1,400,000 was represented by the same amount in cash. The rate of progress in the four shafts has been very satisfactory, and the values of the reef struck in two shafts are most satisfactory. With two large prospective producers like the Van Ryn Deep and Government Areas looming in the future, with the new mill of the Consolidated Langlaagte completed and levelopment of the southern section well advanced, and with the positions at the six other producers in a satisfactory state, the outlook for the future of the Barnato group is undeniably good.

The steady expansion of profits recorded by mines under the control of the Johannesburg Consolidated Investment Company is certainly one of the brightest features of the industry to-day. In January the aggregate profit earned by the seven productive subsidiaries of the group was £58,755. During the "short" month of February there was a temporary decline to £57,611, but in March the earning improved to £60,455, in April to £62,603, in May to £65,419, in June to £66,958, and in July a profit of £67,755 resulted. The New Rietfontein Estate is the only mine of the Barnato group which has not increased its profits since the commencement of this year. Thus the Consolidated Langlaagte's earning has advanced from £8,117 to £10,300, that of the Ginsberg from £5,790 to £7,216, of the Glencairn from £2,906 to £3,039, of the New Primrose from £17,015 to £19,339, of the New Unified from £4,826 to £5,069, and the Witwatersrand from £15,845 to £19,242. These are exceedingly satisfactory and encouraging improvements. It is, furthermore, assured that the profits will increase still more in the near future, if not the immediate future. About the middle of this month the new Consolidated Langlaagte equipment started milling. There have been one or two trial runs of the plant, which have been quite satisfactory. Everything is now ready for a commencement of milling operations proper, but it is not anticipated that sufficient power will be forthcoming to operate the new plant for a fortnight or so. The Van Ryn Deep should be producing twelve months from date, and later on the Modderfontein Government Areas will enter the output list. Of course, the development and equipment of this latter property, with its huge area of 2,633 claims, will take many months of hard and patient work before a single ounce of gold is produced. It is, however, assured that the Government Areas will, within the next few years, become one of the most noteworthy producers on the Witwatersrand. Development is being pushed on with all speed. A considerable amount of time is, of course, occupied in cutting shaft stations, and it will be some time before rock drills can be employed in the vicinity of the north-east shaft as are being used in the north-west shaft section.

The New Primrose, Witwatersrand, Ginsberg, New Unified, and Glencairn are all doing well, and at the New Rietfontein there are encouraging features to be noted. Latest developments in the No. 1 shaft section, or the west end of the mine, are of a promising nature, and the management is hopeful of good returns from this area. Exploratory work is also commencing in the northern end of the mine between Nos. 4 and 5 shafts, and it is hoped that good results will be obtained from here also. Attention may again be directed to the substantial profits earned by the Glencairn on ultra low grade ore. There is little prospect of an improvement in the recovery at this mine, but there is every reason for believing that the mine will continue to earn fair profits for some years to come. A decline in grade of half a dwt. per ton or more would well-nigh render the Glencairn an unprofitable mine, unless a further reduction in the already remarkably low rate of expenditure could be brought about. Happily, however, there is every likelihood of the present grade being maintained.

THE CONSOLIDATED LANGLAAGTE REDUCTION WORKS.

A Modern Plant on Tried and Conservative Lines—Solidity, Convenience and Efficiency Aimed at—Description of the Several Units.

"In the designing of our reduction plant," said Mr. J. Munro at the annual meeting of the Consolidated Langlaagte Mines, Ltd., some time ago, "our engineers have made use of the best information available as regards the latest Rand practice, and, while it includes nothing of an experimental nature, the plant will compare favourably, from the point of view of efficiency, with any on the fields." An inspection of the new plant, which is now fully completed, abundantly bears out what Mr. Munro has said briefly and modestly in a very few words, and it may be doubted if there is any other plant on the Rand, even the most modern, which is better adapted to the work expected of it from an all-round point of view than that of the Consolidated Langlaagte. There is no doubt as to what it will do when in full running order, for everything has been designed and constructed upon well-understood lines, and nothing has been done tentatively, even in small matters.

Sorting and Crusher Station.

The ore from all the shafts on the property will be conveyed by electric haulage to a main receiving bin, which is located midway between the mill and the sorting and crusher building. This bin is built of ferro-concrete below the tram-line level, and delivers through shoots on to three incline elevator belts. Four belts are provided for, but only three will be run for the present. No separation into coarse and fines is made at any of the headgears, so that all the ore from the mine, unclassified, will be conveyed by the elevator belts to the trommels at the head of the sorting belts. A sizing will take place here, the fines going to a cross belt below and the coarse being fed on to the sorting belts, after the usual preliminary washing in the trommels. There are three of the latter, of course, one for each sorting unit. From the discharge end of the trommels the sorting belts rise on the incline for a short distance and then run on the level for the remaining distance. They are 50 feet between centres, and of this length about 30 feet are available for sorting purposes. The waste rock is dropped through shoots into a couple of waste bins below, while a third bin, near the dischargo end of the belts, is used for receiving mill pebbles. The waste rock is trammed from the waste bins to the dumps, while the mill pebbles are discharged at stated times on to a cross belt, which, like that receiving the fines from the trommels, delivers on to the main incline belt to the mill. The sorted rock is delivered into jaw crushers, 39 inches by 17 inches, and thence on to the same cross belt which intermittently receives the feed from the mill pebble bins. Each sorting and crushing unit has its own group of motors.

The Battery.

The fines and crushed ore from the sorting and crusher station are delivered, by the two cross belts referred to, to a main incline conveyor belt, which rises to the topmost floor at the centre of the mill building. This belt runs along the western side of the station, and its housing is clearly shown in one of the illustrations herewith. The ore is delivered to a shuttle belt running on a carriage over the mill bin at the end of the main incline conveyor. The mill bin is of steel framing with timber flooring solidly covered with steel sheeting. It has a capacity of 3,000 tons. At the west end of the mill a pebble bin is constructed adjacent to the building, and when the conveyors are running pebbles, the latter are delivered by the shuttle belt to a shoot which feeds directly to this bin. Thence the pebbles are taken by trucks into the tube mill house and fed to hoppers which discharge into Schmitt feeders.

The battery has 100 stamps, each weighing 1,900 lbs., arranged in units of 10 for driving purposes, with five cams to a shaft, and a single motor drive for each pair of shafts. There are three king-posts to each unit of 10 stamps, instead of four, as at Randfontein; but, as will be seen in the picture, these posts are extremely solid, as indeed is the whole timber framing of the battery. The framing is supported on massive concrete foundations, of similar design to those at the Randfontein Central, and having a tunnel from end to end, within which the anchor bolts are conveniently reached.

The mortar boxes are of the modern open-fronted type, while the stamp heads are of the long design usually adopted in modern batteries. The feeders are of the belt variety known as "Comet." The mortar box and cam shaft floors are unusually roomy, and the whole building and machinery are models of what such a combination should be, every requirement for facilitating repair work and operations generally being carefully provided for. The mill supply tanks are situated immediately at the back of the structure on steel supports.

Tube Mill Plant.

There are 10 tube mills to the 100 stamps, the ratio being, therefore, the highest so far reached in Rand practice. Each tube mill is 16 feet by 6 feet, the length being shorter and the diameter greater than usual. The mills are erected at a low level, well below the ground line in fact, and the pulp from the mortar boxes, which are well above it, is thus enabled to flow by gravity to the cone classifier and dewatering plant connected with them. The necessity of pumping and the irregular rush of pulp to the cones which results from this practice is thus obviated. There is one primary cone to each tube mill, and a secondary safety cone, for each pair of tube mills, erected between each pair of primary cones. The overflow from the two primaries goes to the secondary cone of the circuit; the underflow of the secondary is returned to the primaries, and its overflow to the sands plant. The underflow from the primary cones passes through the tube mills to the amalgamated plates, four to each tube, in pairs, back to back, and 5ft. 3in. by 4ft. in area. The pulp flowing from the plates is conveyed by concrete launders in the floor to a main lander leading through into the pump house, and is thence pumped back to the primary cones at the head of the tube mill circuit. From the mill bins, therefore, to the return pumps in the tube mill circuit, everything moves forward by gravity only. The final pulp overflowing from the secondary cones flows along a launder to the pump house, whence it is elevated through a height of 65 feet to the upper level of the sand and slime classifier plant. There is only one entrance from the tube mill building to the plate house, and only one from the latter to the clean-up and smelting-room. There is no exit except by the same way, and thus the fullest protection is afforded against the entry of unauthorised persons to any section of the gold collecting department. The clean-up and smelting-room is supplied with the usual plant and apparatus, and is a spacious and conveniently-arranged place, divided from the plate compartment, upon which it looks down by an extensive grille.

The Pump Houses.

The pump houses, one in which are located the pumps for the tube mills circuit and the other in which are the pumps elevating the final pulp to the classifier plant, are situated one on either side of the clean-up and smelting-room, on the southern side of the plate house. In each are erected a pair of Robeson-Davidson pumps, of which one is intended as a stand-by. Here, as in all the other portions of the mill, the various units are driven separately by motors.

The Sand Plant.

The final pulp from the tube mill plant, after being pumped through a height of 65 feet, as already explained, flows to a series of nine cone classifiers, six of which are primaries, and three secondaries. Each secondary, therefore, takes the underflow from a pair of primaries. A thorough washing of the sand is effected in these cones. From the secondary classifiers the

overflow goes to the slime plant and the underflow to the distributors of the sand collecting tanks. There are three collectors, and the overflow is finally passed over a set of four return sands cone classifiers, which receive also the overflow from the first series of classifiers as it goes on its way to the slime plant. The underflow from these return sands is passed to the pump pit for re-elevation, while the overflow goes along a launder to the slime collecting tanks. It is hoped to be able to divide the mill pulp finally into a sand product comprising 40 per cent. and a slime product comprising 60 per cent. of the whole, the ratio of slime to sand being thus unusually high. With the tube mill the ratio adopted and the careful system of classification in vogue, this end will doubtless be fairly closely attained. The sand from the collecting tanks, which are built immediately around the base of the steel structure upon which the classifiers are erected, is delivered to three cross conveyor belts per tank, and thence to a main conveyor belt to the Blaisdell distributor. There are twelve 40ft. treatment tanks in two rows of six each.

The slime plant, which was hurried on to practical completion some time ago, in order that the large stock of accumulated slime might be conveniently taken in hand, is partly old and partly new. There are in addition to the collecting tanks, fifteen 50ft. and three 70ft. treatment tanks, with a combined capacity of 22,000 tons per month. One 50ft. and one 70ft. tank are still to be erected. The extractor house and pump house, connected with the cyanide plant, are of the usual kind and do not call for special description.

The entire work has been under the direction of Mr. J. Kelly, as Construction Engineer, the drawings being prepared at the head office of the Barnato group, the Mechanical Engineer being Mr. A. D. Newman and his assistant Mr. E. W. Hutt.

THE MODDERFONTEIN GOVERNMENT AREAS.

The Reef Intersected at Two Points—Values Apparently Confirm Original Anticipations—The Possibilities of the Undertaking Considered.

With the intersection of the reef series in the north-east shaft of the Government Gold Mining Areas (Modderfontein) Consolidated, Ltd., at a depth of 2,275 feet, the company has now two communications with the ore body, the first having been made in the north-west shaft a few weeks ago, at a depth of 2,395 feet. These shafts are distant, approximately, 3,000 feet along the level of the reefs, the angle of slope between the bottoms of the two shafts, after allowing for the surface contour, being apparently negligible. A level driven to connect these shafts, and continued on either side of the boundary, would have a total length of about 11,000 feet, or considerably over two miles. The distance from each shaft to its complementary developing shaft along the dip is nearly 7,000 feet, and a simple way of describing the arrangement of the main developing and hoisting centres is to say that they are situated at the corners of a parallelogram, having its adjacent sides 3,000 feet and 7,000 feet respectively, and including an area, therefore, of, roughly 500 acres. The total area of the ground held by the company is 2,633 claims, or about 1,800 acres, and the shafts are so arranged that the enclosed parallelogram referred to may be said to lie fairly evenly at the centre of the vast block of ground, and to divide the whole into conveniently accessible portions. It was originally anticipated that the reef series would be intersected at a depth of between 2,100 and 2,200 feet from the surface, and the actual depths reached are thus more or less confirmatory of the accuracy of the estimate. The southern, or dip shafts, are expected to meet with the reefs at a depth of about 3,200 feet, and since the south-west shaft is now down to a depth of about 1,900 feet, and the south-east shaft to a depth of about 2,620 feet, they will probably not arrive at their points of destination until early next year in the case of the south shaft, and towards the middle of the year in that of the south-west shaft. Some record sinking has been accomplished, particularly on the south-east shaft, where, in March last, a footage of 233 feet was attained. The manager, Mr. M. H. Coombe, has an excellent reputation and a long and valuable experience in sinking work, and it cannot be doubted that he will show the same kind of aptitude for rapid development as soon as it is possible to get a fair start from the loading stations at the shafts, where the reef body is now in sight. The intersection is, of course, to open up the mine in comparatively large blocks, on the plan which engineers generally have decided to be the most advantageous for the low-lying reefs of the far East Rand.

The Question of Values.

The values of the reef are, naturally, a question of prime importance, and as far as the north-west exposures are concerned, it will be admitted by all that the results are distinctly gratifying. The hopes entertained with regard to the quality of the ore to be obtained from the Government Mining Areas on Modderfontein have from the commencement been based solely upon the more or less uniform character of the reef over extensive distance in the matter of values, as well as thickness, and the remarkable excellence of the recent strike in the Modderfontein Deep Levels, where 9 dwts. over 10 feet of reef were obtained, goes far to encourage the sanguine expectations formed in respect of the Government claims when the Barnato house put in the tender, which was eventually successful. Taking the recovery of the immediately surrounding properties for the month of June, 1912, commencing with Brakpan Mines on the west, and going round the outcrop ground to Geduld on the east, we find the figures to be as follows:—

	Recovery per ton milled.	Total Working Cost per ton milled.	Profit per ton milled.
Brakpan Mines	32/ 3	17/ 6	14/ 9
New Modderfontein ...	40/10	21/ 8	18/11
Modderfontein B. ...	37/ 5	17/10	19/ 2
Geduld Prop.	26/ 0	20/ 5	5/ 0

The Geduld, owing to working difficulties, makes a comparatively indifferent showing in the matter of profits, although the ore value is by no means unsatisfactory. A rough average of the recoveries tabled is about 34s. per ton milled, and at the lowest figure, with a crushing of, say, 2,500,000 tons per annum, or a similar quantity to that which is being put through the mill at Randfontein, the annual profit should be, with a working cost not higher than that of Brakpan Mines, well over a million.

A Possible Profit.

It is impossible to say what the actual average of the ore is likely to be, but it will be observed that a rough average of the recovery obtained by the Brakpan Mines and the Geduld Proprietary, companies which may be regarded as providing more reliable data for the Government Areas than the outcrop companies, is 29s. per ton milled. It does not appear at all unreasonable, therefore, to assume that a working profit of about 10s. per ton is a possible one, and in view of the evidence of the tabular statement given above, and of the general working conditions which may be expected, many would feel inclined to look upon a profit of 10s. as a minimum. An interesting calculation, on a basis of 27s. recovery and 10s. profit per ton milled, makes it evident that, in accordance with the terms of the Government lease, the company would receive about two-thirds per cent., or nearly 7s., the remainder going to the Treasury. The total profit on an annual crushing of, say, 720,000 tons, on this reckoning, would be, approximately, £250,000, or, say, 17½ per cent. on the share capital of £1,400,000. There is nothing definite as yet to go upon for the purpose of calculations of this kind, but, merely tentative and suggestive as they are, and probably not outside the region of probability, they serve to indicate the magnitude of the interest involved in the future of this immense undertaking.

FRANK SMITH DIAMOND ESTATES AND EXPLORATION COMPANY.

A Brief Account of a Promising Concern.

The Frank Smith Diamond Estate and Exploration Co., Ltd., capitalised at £300,000, in 800,000 shares of 7s. 6d. each, whereof £201,843 15s. represented by 538,250 shares are in issue, owns the whole of the Frank Smith and Welgelegen Mines in the Barkly West district, representing 625 claims approximately, together with 40,845 acres of freehold land excellently situated for farming sheep and cattle, in close proximity to the mines. The recent reorganisation of the company's finances for a cash working capital of £108,000, and the opening up of the mines and erection of new machinery and plant was taken in hand without delay under the direct supervision of Mr. T. G. McLelland, whose name is intimately connected with the diamond mining industry in South Africa.

Substantial progress has been made, both underground and on the surface. The main incline shaft is now down about 300 feet, and it is only a matter of a few weeks when the connection with the mine will be made. Good-looking blue ground is disclosed in many of the principal tunnels. Work is being conducted expeditiously, and washing operations are likely to commence at the end of this year. On the surface all the foundations for the new plant and machinery are complete, and the erection of such machinery as is now on the property is proceeding rapidly. No time is being lost in pushing matters ahead as much as possible, and in view of the advent of washing operations, it will not be amiss to recall the past history of the mine's production and its relation to the results anticipated when the mine is in full working order.

In contemplating this aspect of the company's prospects, it should be noted that the quality of the stones produced is good, the average of the past product sold being 54s. 6d. per carat, even though fully 20 per cent. of the total was sold during the diamond slump. The increase in the value of diamonds of recent years lends itself to the confident assumption that diamonds, which the company sold in 1901-6 at 58s. per carat would now realise from 70s. to 80s. per carat.

The next factor to be considered is the yield, and in dealing with the scale of operations, the minimum yield from a direct treatment plant is taken as 4 carats per 100 loads. This estimate appears to be well on the conservative side, as we find that in 1906 164,744 loads of blue ground from a depth of 113 feet were washed and floored for an average recovery of 4.82 carats per 100 loads.

The next question is that of costs, and in Mr. McLelland's opinion, with an efficient direct treatment plant working on a substantial scale, the costs of treatment should not exceed 1s. 6d. per load. Taking these various factors, i.e., the recovery at 4 carats per 100 loads, a value of 70s. per carat, and the number of loads washed per diem at 4,000, it will be seen that the probable profit per annum on a million and one quarter loads will be £81,250, equivalent to a little over 40 per cent. on the issued capital. Even supposing the costs of treatment have been underestimated, and that 2s. per load is a more correct estimate, then on the conservative estimate the profit will probably be £50,000, equal to 24¾ per cent. on the issued capital.

Taking it, however, that owing to the installation of the up-to-date and better plant an increase of 20 per cent. to 25 per cent. in the recovery on what it was formely, can be effected, it will be found by a little calculation that taking the recovery at 5 carats per 100 loads the probable profits indicated above would be increased to £125,000 and £93,750 respectively, equal to 61.43 per cent. and 46.44 per cent. on the issued capital.

The plant is designed to treat 4,000 loads per diem, equivalent to 1,252,000 loads per annum, excluding Sundays, but assuming that only one million loads are treated per annum with the aforementioned factors substantial profits on the issued capital should be won.

Messrs. Barnato Brothers are largely identified with the company, and associated with them in the direction are Messrs. L. Ehrlich and Co., while Mr. T. G. McLelland is the managing director in South Africa, assisted by a local committee in which the two houses referred to above are represented.

Taking everything into consideration and viewing the prospect from a most conservative point of view, there appears to be a prosperous future before the company as at present constituted.

The Albu Group

GENERAL MINING AND FINANCE CORP., LTD.

(Registered under Transvaal Law.)

Authorised Capital £1,875,000
Issued and Fully Paid Capital £1,875,000
In shares of £1 each, of which Nos. 1 to 1,000 are Founders' shares.

DIRECTORS.

Sir George Albu, Bart., *Chairman and Managing Director in South Africa.*
Leopold Albu, *Managing Director in London.*
Geh. Kommerzienrath Eugen Gutmann.
Martin Luebeck.
Jacob Freudenthal, *alternate* Arthur French.
Franz Urbig.
General Consul Albert Blaschke.
Geh. Regierungsrath Siegfried Samuel.
G. Nathan.

LONDON COMMITTEE.

Leopold Albu, *Chairman.*
Martin Luebeck. F. W. Lunau. Jacob Freudenthal.

BERLIN COMMITTEE.

Geh. Kommerzienrath Eugen Gutmann, *Chairman.*
Franz Urbig. General Consul Alberto Blaschke.
Geh. Regierungsrath Siegfried Samuel.

MANAGERS.

Jacob Freudenthal, *Manager in London.*
Arthur French, *Manager in Johannesburg.*
Gustav Hermann, *Manager in Berlin.*
Jules Ley, *Manager in Paris.*
P. B. Osborn, *Consulting Surveyor.*
E. Farrar, *Consulting Mechanical Engineer.*
J. N. Bulkley, *Consulting Electrical Engineer.*
A. Heymann, *Consulting Chemist.*
M. Torrente, *Consulting Metallurgist.*

TECHNICAL ADVISERS.

J. W. H. Stubbs, R. Pill.

SECRETARIES.

W. H. Betz, Johannesburg.
F. W. Chambers, London.

COMPANIES' SECRETARIAL AND TRANSFER DEPARTMENT.

J. V. Blinkhorn, Johannesburg.
T. F. Thorne, London.

OFFICES.

Johannesburg, General Mining Buildings, Marshall Square, P.O. Box 1242.
London, Winchester House, Old Broad Street, E.C.
Berlin, 51, Markgrafenstrasse, W.
Paris, 29, Rue Taitbout.

CINDERELLA CONSOLIDATED GOLD MINES, LTD.

Capital authorised, in £1 shares £1,500,000
Issued Capital £1,159,450
Number of Claims 2,100
Situated on the East Rand on the dip of and to the east of the East Rand Proprietary.
Number of Stamps 100
Number of Tube Mills 3
Commenced crushing October, 1908.

DIRECTORS.

Sir George Albu, Bart., *Chairman and Managing Director, alternate* A. Rosendorff.

L. Albu	*alternate*	A. French.
J. Freudenthal	,,	W. H. Betz.
George Nathan.	,,	H. W. Dalton.
John Munro.	,,	P. Richardson.
S. B. Joel	,,	G. Imroth.

RESIDENT MANAGER: F. W. Girdler Brown.

SECRETARY AND HEAD OFFICE.

J. V. Blinkhorn, P.O. Box 1173, Johannesburg.

LONDON COMMITTEE.

P. G. Hamilton Carvill. F. W. Chambers.
Jacob Freudenthal.

LONDON SECRETARY.

T. Fredk. Thorne, Winchester House, E.C.

MEYER AND CHARLTON GOLD MINING CO., LTD.

Capital, in £1 shares £200,000
Number of Claims on reef 90
Also water-rights, etc., situated east of Johannesburg, between the City and Suburban and Wolhuter.
Number of Stamps 75
Number of Tube Mills 2
Payable ore reserves, 31st December 1911... ... 312,336 tons

DIRECTORS.

Sir George Albu, Bart., *Chairman and Managing Director, alternate* A. Rosendorff.

Leopold Albu	*alternate*	W. H. Betz.
George Nathan.		
A. French	,,	H. W. Dalton.

RESIDENT MANAGER: H. G. Nitch.

LONDON COMMITTEE.

P. G. Hamilton Carvill. Jacob Freudenthal
George Rolfes.

SECRETARY AND HEAD OFFICE.

J. V. Blinkhorn, General Mining Buildings, P.O. Box 1173, Johannesburg.

LONDON SECRETARY AND OFFICE.

T. Fredk. Thorne, Winchester House, Old Broad Street, E.C.

WEST RAND CONSOLIDATED MINES, LIMITED.

Capital £2,025,000
(2,000,000 ordinary shares of £1 each and 25,000 deferred shares of £1 each.)
Issued Capital £2,004,424
(1,979,424 ordinary shares and 25,000 deferred shares.)
The company's assets comprise 2,040 claims on the farms Luipaardsvlei, Rietvlei, Waterval and Uitvalfontein.
Number of Stamps 100
Number of Tube Mills 4
Number of Claims on reef 1,908
Commenced crushing in September, 1908.

DIRECTORS.

Sir George Albu, Bart., *Chairman and Managing Director.*

Leopold Albu	*alternate*	H. W. Dalton.
C. S. Goldman	,,	R. Goldman.
W. H. Dawe	,,	A. G. Gill.
A. Brakhan	,,	H. Neuhaus.
J. Friedlander	,,	G. C. Fitzpatrick.
G. Nathan	,,	A. Rosendorff.
A. French	,,	W. H. Betz
S. C. Black	,,	B. Moses.

LONDON COMMITTEE.

Leopold Albu, *Chairman.*
J. Freudenthal. C. S. Goldman.
A. Brakhan. J. Friedlander.
C. Pakeman.

SECRETARY AND HEAD OFFICE.

J. V. Blinkhorn, General Mining Buildings, P.O. Box 1173, Johannesburg.

LONDON SECRETARY.

T. Fredk. Thorne, Winchester House, E.C.

AURORA WEST UNITED GOLD MINING CO., LTD.

Authorised Capital, in £1 shares £362,500
Issued Capital £212,705
Number of Claims on reef 116.5
Situated west of Johannesburg, between the New Unified and Bantjes Consolidated.
Number of Stamps 80
Recommenced crushing August, 1908.

DIRECTORS.
Sir George Albu, Bart., *Chairman and Managing Director*, *alternate* A. Rosendorff.
Leopold Albu *alternate* A. French.
George Nathan ,, W. H. Betz.
RESIDENT MANAGER: J. P. Ward.

SECRETARY AND HEAD OFFICE.
J. V. Blinkhorn, P.O. Box 1173, Johannesburg.

LONDON COMMITTEE.
P. G. Hamilton Carvill. Jacob Freudenthal.
F. W. Chambers.

LONDON SECRETARY.
T. Fredk. Thorne, Winchester House, E.C.

THE VAN RYN GOLD MINES ESTATE, LIMITED.

Capital, in £1 shares £550,000
Estatea of 7,944 acres. Mining claims on reef ... 188
Situated on the East Rand, immediately north of Modderfontein.
Number of Stamps 150
Number of Tube Mills 6
Payable ore reserves, 30th June, 1911 ... ... 1,655,910 tons

DIRECTORS.
F. A. Gillam, *Chairman*. ...
Sir George Albu, Bart., *Managing Director*.
P. G. Hamilton Carvill. L. B. Burns. L. Albu.
John Sear. J. Freudenthal.

SECRETARY AND HEAD OFFICE.
Stuart Hogg, Winchester House, London, E.C.

MINE MANAGER: E. G. St. John.

JOHANNESBURG SECRETARY. ...
J. V. Blinkhorn, General Mining Buildings, Marshall Square, Johannesburg.

NEW GOCH MINES, LIMITED.

Capital, in £1 shares £550,000
Number of claims on reef 125.5
Situated on Central Rand, between the Wolhuter and Henry Nourse.
Number of Stamps 120
Number of Tube Mills 4
Payable ore reserves, 31st December, 1911 ... 962,575 tons

DIRECTORS.
Sir George Albu, Bart., *Chairman and Managing Director*, *alternate* A. Rosendorff.
Leopold Albu *alternate* A. French.
J. Freudenthal ,, W. H. Betz.
G. Nathan.

SECRETARY AND HEAD OFFICE.
J. V. Blinkhorn, P.O. Box 1173, Johannesburg.

LONDON COMMITTEE.
P. G. Hamilton Carvill, *Chairman*.
Jacob Freudenthal. Robert Whyte.

LONDON SECRETARY.
T. Frederick Thorne, Winchester House, Old Broad Street, E.C.

RAND COLLIERIES, LIMITED.

Issued Capital £631,250
Number of Claims 828
Property consists of the freehold of the central portion of the farm Witpoort No. 12 in the East Rand district, between the mines of the East Rand Proprietary Group and the Van Ryn and Kleinfontein Companies (including coal mining rights), in area 2,951 acres, and the coal rights of a further portion of the same farm, in extent 2,958 acres.
Shaft intersected reef in February, 1908, since which some very rich values have been opened up in places during development.

DIRECTORS.
Sir George Albu, Bart., *Chairman*.
Leopold Albu *alternate* A. Rosendorff.
George Nathan.
A. French ,, W. H. Betz.

LONDON COMMITTEE.
P. G. Hamilton Carvill. J. Freudenthal.
F. W. Chambers.

MINE MANAGER: R. M. Kayser.

SECRETARY AND HEAD OFFICE.
J. V. Blinkhorn, General Mining Buildings, P.O. Box 1173, Johannesburg.

LONDON SECRETARY.
T. Fredk. Thorne, A.C.A., Winchester House, E.C.

ROODEPOORT UNITED MAIN REEF GOLD MINING COMPANY, LIMITED.

Issued Capital, in £1 shares £460,000
Number of Claims on Reef 458.7
And freehold equal to 767 acres of portion of farm Roodeport No. 43.
Situated in the Roodepoort district to the north and east of the Durban Roodepoort Deep.
Number of Stamps 100
Payable ore reserves, 31st December, 1911 ... 448,800 tons

DIRECTORS.
Sir George Albu, Bart., *Chairman and Managing Director*, *alternate* W. H. Betz.
Leopold Albu *alternate* A. French.
G. Nathan ,, A. Rosendorff.
H. Neuhaus ,, G. D. Stollreither
M. G. Elkan ,, V. J. Ronketti.

SECRETARY AND HEAD OFFICE.
J. V. Blinkhorn, P.O. Box 1173, Johannesburg.

LONDON COMMITTEE.
P. G. Hamilton Carvill. F. W. Chambers.
J. Freudenthal. A. H. Marker.

LONDON SECRETARY.
T. Fredk. Thorne, Winchester House, Old Broad Street, E.C.

NEW STEYN ESTATE GOLD MINES, LIMITED.

Capital, in £1 shares £300,000
Number of Claims 2,728
Area of freehold properties belonging to the company equals 11½ English square miles. Situated mainly to the south of the rich Roodepoort section of the West Rand. Excess of liquid assets over liabilities on 31st December, 1911, £89,308.

DIRECTORS.
Sir George Albu, Bart., *Chairman and Managing Director*.
Leopold Albu *alternate* W. H. Betz.
J. Freudenthal ,, A. Rosendorff.
G. Nathan.
A. French.

SECRETARY AND HEAD OFFICE.
J. V. Blinkhorn, P.O. Box 1173, Johannesburg.

LONDON COMMITTEE.
P. G. Hamilton Carvill. Jacob Freudenthal.
Robert Whyte.

LONDON SECRETARY.
T. Fredk. Thorne, Winchester House, E.C.

SACKE ESTATES AND MINING COMPANY, LTD.

Nominal Capital, in £1 shares £250,000
Issued Capital £225,000

DIRECTORS.
Sir George Albu, Bart., *Chairman*, *alternate* A. Rosendorff.
A. French *alternate* W. H. Betz.
Geo. Nathan.

SECRETARY AND HEAD OFFICE.
J. V. Blinkhorn, P.O. Box 1173, Johannesburg.

LONDON COMMITTEE.
F. W. Lunau. J. Freudenthal. R. Whyte.

LONDON SECRETARY.
T. Fredk. Thorne, Winchester House, E.C.

THE ALBU GROUP.

Sir George Albu's speeches at the annual meetings of half-a-dozen companies of his group, held recently, were models of the businesslike pronouncements in fashion to-day. There was little about labour, less about the share-market, and nothing at all about politics in any shape or form. Throughout each speech he stuck closely to the facts regarding each mine, and through all there ran the golden note of optimism that has never failed or deceived the leader of the Albu group. Regarding the sharemarket, Sir George could only echo the pious hope that it would mend in good time to supply companies such as the Rand Collieries, New Steyn Estate, Roodepoort United, and Aurora West with the needed capital to realise their industrial possibilities. Most of the mines of the group are still in a state of transition. The Meyer and Charlton has only just got into its stride, after the recent change and temporary stoppage; the Cinderella Consolidated and West Rand Consolidated are still in what may be called preparatory crushing stages; the Roodepoort United is still developing its ground; the Rand Collieries awaiting more capital to push on; and the New Steyn Estate and Sacke Estate are marking time. Of the Goch alone may it be said that, were it not for labour troubles, it would be working at normal pressure. The Meyer and Charlton, however, will soon show what it can do. At the Roodepoort United Main Reef there has been a reduction in the ore reserves, but now that the Kimberley shaft has been sunk sufficiently to permit of the opening up of several new levels, it is hoped to overtake the depletion. The New Goch working profit is lower by £14,223, in spite of a larger crushing. Native labour troubles have been the main factors in bringing about these untoward results. On the other

hand, the ore reserves have been augmented by 220,887 tons. Sir George warned shareholders that a great deal of work will be necessary before it will be possible to win ore from the higher grade ground. Therefore the recovery in output and profits which he confidently anticipates can only come about gradually. The West Rand Consolidated has suffered from the shortage and expensiveness of native labour. Last year the ore milled was 77,000 tons more than that dealt with in 1910, yet the profit only went up by £10,000. The development programme had to be curtailed. Recent development operations have yielded greatly improved results as regards grade, and have replenished the reserves at a more rapid rate than mining has depleted them. At the Cinderella Consolidated the result of last year's work was to increase the payable ore reserves by 318,273 tons. Sir George Albu estimates that by the end of this year the reserves will attain 1,500,000 tons. It will then be practicable to enlarge the capacity of the crushing plant to an extent commensurate with the company's claim-holding. At the Aurora West the capacity of the milling plant has been increased, and a scheme for capitalising the company's debt is to be submitted in May. The year, it will be seen, was a trying one, but the net results must be written down as satisfactory in the face of difficulties, and the outlook is most promising.

SOME LEADING MINES OF THE GROUP.

CINDERELLA CONSOLIDATED GOLD MINES.

A Great Deep Level—Ambitious Schemes of Development—Connection with the E.R.P.M. Established—Excellent Driving and Survey Work.

The original Cinderella Deep property was of a size and shape inconsistent with the best and most approved ideas of deep level working and economy. Previous to the absorption of large blocks of ground to the east, and the alteration in title from Cinderella Deep to the more comprehensive Cinderella Consolidated Gold Mines, Ltd., the company possessed only 289 claims. The distance along the strike was 2,200 feet, and on the dip 4,000 feet; in other words, the width of the property from east to west was but little more than half the length of the claims from north to south. Obviously such a proposition would be far from ideal in extent and shape, and in May, 1910, the whole aspect of the Cinderella was greatly changed for the better by the purchase of 1,812 adjacent claims acquired from the Government, the East Rand Proprietary Mines, the Johannesburg Consolidated Investment Company, and others. The greater Cinderella accordingly consists to-day of 2,100 claims, all in one compact block, with the exception of 28 claims in the extreme western portion of the area. The distance along the strike of the reef is now between sixteen and seventeen thousand feet; in other words, the width of the property from east to west has been increased nearly eightfold.

Chief Points of Attack.

In considering the present-day position of this exceptionally interesting property, it is first of all necessary to fix in one's mind the principal points from which exploitation of the property is proceeding and the relation of these points to one another and to the boundaries of the company's area. The original property was opened up by means of one shaft, which may for purposes of convenience be termed the Cinderella shaft throughout this article. Situated 4,800 feet to the east of the Cinderella headgear is the new central shaft of seven compartments, 42 feet by 6 feet inside timbers. This shaft, as its name denotes, is destined to play a most important part in the development of the Cinderella Consolidated; it will, in fact, constitute the chief point in the company's programme of exploitation.

The Cinderella's History.

Before proceeding with a description of the property and the work proceeding, it will be necessary to recapitulate the history of the company in order more clearly to define the present position. The Cinderella Deep was originally registered in 1895. Nearly eleven years later the shaft intersected the South Reef at a depth of 4,000 feet, and a level was then started towards the Hercules property, in order to secure a second outlet to the surface through the shaft of that company. The absence of a second shaft has for long proved a thorn in the company's side. It has hampered the company's programme of expansion, for, as is well known, the Government only permits operations to proceed on a restricted basis until a second outlet has been established. However, after a thorough investigation of the Cinderella Deep's claims for favourable consideration by a Commission appointed by Government to enquire into and advise on the carrying on of mining and milling operations by single outlet, the Cinderella Deep commenced crushing on September 27, 1908, with 50 stamps (1,650 lbs.), and two tube mills. Another 50 stamps were ordered, and a further tube mill in December, 1908, and 30 of these were started eleven months later. The statistical history of the company up to the end of 1910, in so far as productive operations are concerned, is reflected in the following figures:—

Year	Stamps at work.	Tons Milled.	Revenue. £	per ton.	Expenses. £	per ton	Profit. £	per ton
1908	50	33,329	45,362	27/ 2	37,554	22/6	7,808	4/ 8
1909	52½	157,548	229,831	29/ 2	170,563	21/8	59,268	7/ 6
1910	65	181,100	256,541	28/ 4	208,613	23/0	49,928	6/ 3

The 1911 results are dealt with on another page.

Cramped Operations.

Whilst these essentially cramped productive operations were proceeding, every effort was made to advance the development of the mine. Endeavours were simultaneously forced to effect connection with one of the shafts now included in the East Rand Proprietary fusion, and thus remove the disadvantages under which the company laboured. In these efforts the company has been singularly unfortunate. After the closing down of the Hercules shaft, driving to the Angelo Deep shaft was proceeded with, and when only 150 feet remained to be driven the board of management of the East Rand Proprietary decided to close down the Angelo Deep section. Then it was decided to join up with the Cason, and in the middle of July this work was commenced, it being incumbent on the Cinderella Consolidated Company to effect connection by the end of November.

Linking Up the Shafts.

The work of making this connection must surely be accounted amongst the most remarkable ever carried out in the history of mining. Connection with the Cason shaft was effected at midnight on November 30th, 1911. It is worthy of special note that the connection was made within five minutes of the actual time limit stipulated, and that the point in the Cason shaft towards which driving was directed was only distant six inches from where the drive holed through. In order to make this connection the company drove through Boksburg Township ground and cross-cutted 800 feet, when reef was encountered. This reef was driven on to the western boundary. In driving to the Cason a dyke was encountered and the reef lost. As time was a most important consideration, the reef was not looked for, but a diagonal cross-cut was carried in. The objective point to which driving was directed was determined by the East Rand Proprietary Mines, namely, a point on the 23rd level in the Cason shaft. The error, as has been already stated, was only six inches. This is all the more remarkable when it is borne in mind that the survey was taken from shaft timbers and expensive plumbing was dispensed with. The rate at which driving was carried out calls for mention. It was on July 16 last that driving towards the Cason was agreed on. In four and a half months 1,114 feet were driven, that is the rate of driving was 247 feet per month. In carrying out this work Holman rock drills (3¼ inches) were employed. Another excellent piece of work was carried out in the Cinderella Consolidated when driving towards the Angelo Deep was proceeding with a view to linking up these two mines. It will be recalled that when the drive was within 150 feet of the Angelo Deep shaft sinking was stopped, but during the period driving was proceeding 1,931 feet of tunnelling were achieved in thirteen months. Here, too, Holman drills were employed.

Sinking operations in the Cason were carried out with considerable difficulty, as the ground was bad and machine bars had to be used to hold the roof up. However, the connection has now been satisfactorily established, and the Cinderella Company is free to proceed with its programme of expansion. It may here be of interest to remark that from the collar of the Cason shaft to the bottom of the Cinderella incline is now 7,120 feet on the incline.

Development Plans.

All the development work done so far in the mine has been carried out in the western, or old Cinderella Deep section, so that by far the greater part of the property remains untouched. The company's lower levels are not yet quite connected up with the 3,000 feet section, at which level intersection has been made. A raise is up on the North Section Reef to 3,200 feet, and a winze is down from 3,000 feet to within 20 feet of this level. There now remain 245 feet to be driven west to connect these points, and when this is effected the upper and lower workings will be linked up. The ventilation of the mine may be deemed good. A large Capell fan has been put in, and two Stine fans are to be installed, one at the bottom of the vertical shaft and one at 3,000 feet. Drives from the Cinderella shaft are proceeding, and it is anticipated that when connection between the western and central sections is made the ore blocked out will amount to approximately three million tons.

Throughout last year the policy of the company was to push on with development, to secure sufficient stope faces to enable mining to be carried out on single shift only, and to enable development to be carried out on single shift also. Of course the drive to the central shaft, which has now been advanced 2,300 feet, has been and will be pushed on with all speed.

Obviously the results secured at the Cinderella to date cannot in any way be taken as representative of the capabilities of the mine. The property has always suffered from the disadvantage of having one shaft, and has laboured under the penalties attaching to such a state of affairs.

The company has had a chequered career, but, with anything approaching an adequate supply of native labour, it could afford to laugh at past experiences and push rapidly on to that goal of achievement which is to make the Cinderella one of the leading propositions of the Witwatersrand. As it is, the company is exceedingly short of native labour, and it has been in the face of very great difficulties that the connection work has been carried out, whilst at the same time the mill has been kept running, small profits have been earned and development work has proceeded with a view to opening up large tonnages of ore in the central section of the property. The milling plant of the Cinderella Consolidated Company consists at present of 100 stamps and three tube mills. It is, of course, intended greatly to enlarge this plant, and it is hoped that in three or four years' time the company will be crushing at the rate of 100,000 tons per month. Of course much depends on native labour. Now that connection has been effected with the Cason, the Government regulations permit of augmentation of the underground labour force to an indefinite degree. The company require, however, a few hundred more boys before the full complement for the present existing milling plant is available.

Splendid Prospects.

The technical advisers to the General Mining and Finance Corporation estimate the ore contained in the combined area of the Cinderella Consolidated to be in excess of fifty million tons, and look for a profit in the neighbourhood of about 10s. per ton. The intention is to increase the capacity of the plant to 1,200,000 tons per annum in the first place, and to 2,500,000 tons per

annum at a later date. There can be no manner of doubt as to the magnificent prospects and great possibilities of this mine. A few months ago Sir George Albu remarked that he would not willingly exchange the company's prospects for those of any other mining proposition on these fields. He further demonstrated his confidence in the Cinderella by stating that "by the time the present available funds have been expended on further construction work, we shall have spent in the region of one and a quarter millions of solid cash on the equipment and development of your property (quite apart from the considerable amount of money raised for and laid out in the purchase of additional claims)."

The Cinderella Consolidated is a property of which merely the first pages of life history have been written. What the total duration of productive and profitable operations will be, no one can say; neither is one justified in advancing any calculations as to the ultimate yield of the mine or the total sum the company will distribute in the form of dividends. At the present juncture one is not entitled to go further than state that the area controlled is over 2,000 claims, that evidences are distinctly in favour of the view that practically the whole proposition will, sooner or later, be worked at a profit, and that the results so far secured are wholly unrepresentative of the dividend-paying abilities of the company, which can only become manifested when the mine is crushing on a scale commensurate with its size and potentialities.

MEYER AND CHARLTON G.M. CO.

A New Mine with a New Plant—Sound Underground Position—Improving Returns Announced—Plant Operated Entirely by Electricity.

The fortunes of the "house" of Albu, or the General Mining and Finance Corporation, have always been intimately associated with those of the Meyer and Charlton gold mine, and the present position of this famous property, which is named after two pioneers who helped to make history in the infancy of the Witwatersrand, is one on which the firm of which Sir George Albu is the presiding genius is thoroughly to be congratulated.

The Wealth of the Outcrops.

It is a striking and important fact that over a very large extent of the Witwatersrand the older outcrop mines are now manifesting much improved positions. Their rich upper levels have been exhausted, and from their lower workings they are securing profits per ton which compare most favourably with earnings when a mill recovery of an ounce to the ton was deemed nothing out of the ordinary. We have in recent issues referred at some length to the gratifying developments at the City and Suburban and the Ginsberg—two well-known and long-established ventures. The Meyer and Charlton may be placed in the same class of improving propositions, and that these mines should lately have encountered much better ore as their southern boundaries are approached is a valuable and convincing refutation of the hardy old misconception that the auriferous conglomerates become impoverished in depth.

During 1911 a working profit of £94,789 was earned, despite the fact that the mill was closed down from February 27 to June 3. Having regard to this, the 1911 profit compares most favourably with the earnings secured in 1910, when milling was carried out without interruption throughout the year, and £112,926 resulted. Moreover, the rate of dividend-earning was maintained at 40 per cent., £80,000 being distributed. The company has since its inception distributed over a million sterling amongst shareholders—to be correct, £1,035,309—a record of which the company and all those associated with it may be justly proud.

Additional Ground and New Equipment.

Within the last year or so the affairs of the Meyer and Charlton have undergone a radical change for the better. By the acquisition of the 40.7 deep level claims of the Lark Syndicate in 1909, and of the undermining rights in respect of 13.72 bewaarplaatsen claims from the Government, the life of the mine has been lengthened and the general outlook for the company vastly improved. At the end of 1910 it was calculated that the company held 55¼ intact reef claims. It may be recalled that the consideration payable to the Government in respect of this ground has been fixed at an interest of 11.06 per cent. in the annual net produce of the company. Not only may the Meyer and Charlton be said to possess a new mine, but it is quite as true to remark that the company possesses a new equipment as well. On February 27, 1911, milling temporarily ceased and construction work and widening of the shaft from three to five compartments were commenced. Milling was resumed on the 3rd June, and incidentally it may be observed that advantage was taken of the stoppage to increase the ore reserves by about 40,000 tons of an average assay value of 12.6 dwts. per ton. The new equipment includes a new steel headgear and ore bins of most modern design and in marked contrast to the old timber structure which had, nevertheless, rendered yeoman service. There are a new rock breaking and sorting plant, an electric winder for hoisting five-ton skips, and a new electric 30-drill compressor, which latter installation has only recently been completed. Furthermore, the mill has been renovated and the former three-ton steam driven hauling engine has been converted into an electric winder. The necessary buildings have also been erected.

The Underground Position.

The grade of ore below the 14th level down-throw is quite satisfactory, and one can at least state that the stratigraphical disturbance has had no ill-effect on the value of the ore. Another most encouraging feature is the development results secured on the pyritic band, which is worked in this mine as well as at the adjacent Wolhuter and other mines on the Rand. Hitherto the greater part of this ore body which is mined at the Meyer and Charlton has been drawn from the 14th level, but very encouraging results are now being obtained on the 17th level, and the management is preparing to put in a cross-cut to intersect this reef at the 18th level.

No Steam Plant Employed.

Now that the electric compressor has been installed, the Meyer and Charlton is a mine which does not generate a single pound of steam power; indeed, with the unimportant exceptions of a boiler in the change house and a boiler for cooking in the compound, there is absolutely no steaming plant on the property. The mine is entirely operated by electricity; it is without any steam stand-by plants, and is therefore, one might say, entirely at the mercy of the Victoria Falls and Transvaal Power Company. Having regard to the recent failures of this concern to fulfil contracts, the wisdom of doing away with emergency equipments is open to question. At the same time, in justice to both the managements of the Power Company and the Meyer and Charlton, it should be pointed out that during the past two months not one single minute of running time has been lost at this mine through any faults of the power concerns.

Native Labour.

The Meyer and Charlton, like the majority of other Central Rand outcrop mines, is a favourite with natives, and is well supplied with unskilled coloured labourers. The complement of the company to-day is about 1,000, but machines are still employed in the property on stoping operations.

A Bright Outlook.

The prospects of the company are, as a matter of fact, exceedingly bright. Taking into consideration the underground position, the much extended length of "life" secured to the company by reason of the new ground, the excellent state of the equipment and the very satisfactory positions with regard to finance and labour, we can state with confidence that there are few mines in South Africa or elsewhere which can boast of such a generally assured position as the Meyer and Charlton.

WEST RAND CONSOLIDATED MINES, LTD.

A Huge Concern Awaiting More Labour—Last Year's Profits Slightly Greater than in 1910—The Development Position Extension of Slimes Plant.

Few, if any, mines on these gold fields have felt the pinch of labour shortage more acutely than the West Rand Consolidated Mines, that great fusion of mining areas lying immediately to the west of the township of Krugersdorp, achieved by the General Mining and Finance Corporation at the beginning of 1907. Here is a property of over 2,000 claims, with an outcrop of 2½ miles along the strike. The West Rand Consolidated constitutes, in fact, one of the largest concerns operating on the Witwatersrand, and the development and equipment have been laid out with a view to the treatment of a vastly larger tonnage than is being crushed at present.

A Vast Tonnage Awaiting Treatment.

It is obviously inconsistent with the generally accepted principles of mining economics that a property in which the Main Reef series is contained in 1,908 claims, of which 716 claims are also underlaid by Battery Reef, should be operated on a basis of 100 stamps and 4 tube mills. At the present rate of exhaustion the "life" of the concern must be enormous, and even if operating with an equipment four or five times as great as that at present in use the period of productivity would be in excess of the average for Rand mining undertakings. Only by working on a large scale can this company make really adequate returns. The mine has, as already remarked, been laid out with a view to expansion and extension, but last year, owing to the prevailing shortage of native labour, the company suffered by reason of the large area over which shafts, etc., are distributed, and because it was at that time in consequence of the lack of labour impossible to push ahead with development to the desired extent and at the same time earn adequate profits.

The Shafts

There are a number of shafts on the property of both outcrop and deep level character. On the Main Reef section there are at outcrop the Nos. 1, 2 and 3 shafts, of which the Nos. 1 and 3 are now working. To the south of these are the west and east shafts. The former is a seven-compartment incline sunk on a dip of 50 degrees to 1,450 feet. The east shaft may be described as a semi-deep; it has been sunk to 1,850 feet, and is in close proximity to the mill and treatment plants. Over both these shafts strong headgears have been built, and the general equipment around the pit heads is of a thoroughly efficient and modern type. Particular mention may be made of the electric winders at the west shaft. These two shafts are designed to play a highly important part in the future development of the West Rand Consolidated. Each is designed to handle a large tonnage of ore, and we should imagine that a milling equipment three or four times as large as is at present utilised could easily be fed from these two shafts. The scheme of underground ore transport as between these two new shafts and the shafts at outcrop is briefly as follows:—Rock from the No. 1 shaft section is gravitated down to the east shaft and thence hauled to surface. No. 3 shaft ore is gravitated down to the west shaft station and then hoisted. The crushing and sorting houses at this west shaft are connected by a 24-inch locomotive track with the Battery.

The Battery Reef.

In the Battery Reef section—to the south of the Main Reef area—three shafts have been put down: the Violet, the Flora and the Southern or Rand shaft. At present this latter shaft is the only one working. It is a 40 degrees incline of three compartments and is connected up with the mill by a locomotive track. Development is now being pushed on with in this section with very successful results as to value and quantity. The work done on this reef, espeeially during recent months, points to this ore body being a much more important factor in the future of the mine than has been hitherto surmised.

The Mill and Cyanide Plants.

The present reduction and treatment plant of the West Rand Consolidated Mines consists of 100 stamps and 4 tube mills. There are 60 of the old Violet stamps in the battery, 20 medium weight heads and 20 heavy stamps. The duty per head during

the last quarter of 1911 was 12,046 tons per day. The slimes plant is now being extended; otherwise there are no additions to equipment in progress at the present day.

It is patent that there are all the makings of a really big concern at the West Rand, a proposition which, although of comparatively low grade in the past, is likely from indications of actual recovery from the mill and current development to appreciably improve in this respect in the near future. As a matter of fact, judging from the most recent development values disclosed, and the excess development which is now being effected, it is extremely probable that by the end of next year the existing reduction plant will have been increased to such an extent as to admit of the treatment of from 50,000 to 60,000 tons per month, *i.e.*, about double the present output.

ROODEPOORT UNITED MAIN REEF G.M. CO., LTD.

A Difficult Proposition—Underground Development—The New Plant and the General Outlook.

The working profit earned by the Roodepoort United Main Reef Company last year was £81,897, or an increase of £52,830 over the figure for the preceding year.

The fall in profits during the current year may be regarded as a temporary phase, and one which will disappear after the necessary connections between the Kimberley east section have been erected and the opening up of the new levels from the Kimberley main shaft have been completed.

At the annual meeting Sir George Albu said, *inter alia*:—"It will be observed that the payable ore fully developed at December 31 last, although giving a slightly higher value over a larger stoping width, shows a decrease of 168,935 tons as compared with the payable ore reserves at the end of the previous year; in other words, that we only developed some 270,000 tons of payable ore during the year, as against 440,000 tons mined. This would at first sight appear to be a somewhat serious feature, and I am glad therefore, of the present opportunity of assuring you that it does not merit the importance that some shareholders may have been inclined to attach to it. It was pointed out by the chairman at the annual meeting of your company two years ago that the South Reef (the more consistent ore body as regards gold contents in the Roodepoort district had then been almost entirely worked out in the old United section, and that as regards this reef the newly-acquired Kimberley-Roodepoort section must for the future be viewed as the main source of supply. It is clearly explained in the manager's report for the past year that the proper development of the South Reef in the Kimberley section could only be effected to a limited extent until the sinking of the main incline shaft in this portion of the property had been carried to a sufficient depth to allow of additional levels being opened up. I have already pointed out that considerable progress in this respect was made during the past year, and I may supplement this statement by informing you that the work has not been allowed to fall into arrear during the last four months."

The Roodepoort United section has now been developed down to the 12th level—the southern boundary. In the Kimberley section fourteen levels have been opened up; and a large extent of southern ground remains to be exploited. The future development of this portion of the mine is thus of much importance to the company. At the present time 60 per cent. of the ore drawn is hoisted through the Kimberley main and Kimberley east shafts, and the remainder from what is termed the United shaft, the only one on the original propertw now being worked. In the future a still larger proportion will be drawn from the Kimberley sections. The development operations carried out last year totalled just under 15,000 feet, and the ore reserves at 31st December, 1911, stood as under:—

Payable ore fully developed—

South Reef ...	231,300 tons at 6.36 dwts.	over 36 inches.
Main Reef	217,500 tons at 4.56 dwts.	over 48 inches.
	448,800 tons at 5.49 dwts.	over 42 inches.

Unpayable ore fully developed—

South Reef ...	27,000 tons at 2.71 dwts.	over 36 inches.
Main Reef ...506,900 tons at 2.89 dwts.		over 48 inches.
	533,900 tons at 2.88 dwts.	over 47 inches.

It is to be observed that the percentage of unpayable South Reef to total ore developed is far less than for Main Reef, and the future profits of the mine, it seems, will be derived in the main from this ore body in the large blocks of virgin ground in the Kimberley section. A sound development policy is being pursued, and a substantial increase in ore reserves may be expected at a later date.

The New Equipment.

It was estimated some little time ago that with the full mill at work costs would be reduced to about 15s. per ton. This anticipation has not as yet been realised, the working expenses for last year averaging 17s. 2d. per ton, and for the quarter ended June 30th, 1912, 17s. 3d. The full capacity of the mill is, however, 60,000 tons per month, whereas the tonnage milled per month at the present time is about 30,000. During the last quarter only 55 stamps out of 100 erected were at work, and four of the five tube mills were employed. The ore stamped was 94,038 tons. The cyanide plant of the company will have to be added to somewhat before the full crushing capacity is attained, as more treatment tanks are necessary. The new mill and cyanide plant lies to the south of the Kimberley main shaft, and is situated at a considerable distance from each of the three shafts which are contributing ore. The stamps are of 1,900 lbs. falling weight, and the duty is the highest recorded on the Witwatersrand, 19.751 tons per stamp per day being returned for the past quarter. The plant is well designed, and the type of machinery is modern throughout. It is of interest to note that in contradistinction to the City Deep the amalgamating plates are of shaking type and not stationary, as at the great Central Mining Corporation deep level.

Finances and General Outlook.

The labour complement of the company to-day is 3,000, which should be ample for present requirements. The present returns are scarcely satisfactory, but the outlook for improved results is good. Operating on the full stamping basis and crushing about three-quarters of a million tons per annum, a substantial decline in working expenditure will be recorded. At the same time it must be realised that the mine is a difficult one to operate on account of its straggling nature and the cutting out of a number of claims almost in the centre of the mine by faulted ground. The financial position of the company at the end of last year was briefly that liquid assets exceeded current liabilities by £1,136. On the other hand there was a liability of £197,935 to the General Mining and Finance Corporation, which it is proposed to capitalise on the advent of "more favourable financial conditions." The reef-bearing claims of the company number 458.71, and in addition there are held water-rights, bewaarplaatsen, etc., equivalent to a further 78.93 claims. Obviously a very large tonnage of ground remains; but until development has been carried down below the 14th level in the Kimberley section—at present the deepest level in the property—it is difficult to form anything approaching a reliable estimate as to the mill tonnage available. The question of absorbing further areas to the east of the present property has been considered on two or three occasions. As yet nothing has materialised in this regard, but it may well be that a further extension of the Roodepoort United Company's claim area will yet be an important event in the history of this company.

THE PRESENT POSITION OF THE VAN RYN.

A Long and Honourable Record—Solid Character of the Ore Reserve Account—Profits for the Last Financial Year.

With the New Kleinfontein and the Modderfontein the Van Ryn has had the distinction, and, it may be added, the merit of having kept alive the faith in the far East Rand of that portion of the investing public who have never ceased to feel confidence in the future productivity of an area which has latterly come so much into public favour. The Van Ryn has a record behind it which cannot fail to appeal to those who recognise the value of solid consistent performance, and it was with a clear sense of the importance of a record of this kind that Mr. Leopold Albu made the following remarks, *inter alia*, in seconding the adoption of the accounts at last year's annual meeting of the company:—"Your statement of the position and affairs of the company," said he, addressing the Chairman, "is so lucid, and in every detail so instructive as to leave no one, not even the most exacting, in any doubt about it. But if anything had been left in doubt the actual performance of the company for the past nine or ten years speaks louder and far more effectively than anything that can be stated either by the Chairman or myself, and should impress shareholders and the investing public with the soundness of your undertaking. If it is remembered that the company has stood the test of the most critical periods during the past sixteen years that any individual undertaking could have ever had to contend against, then, gentlemen, we have every cause to look forward with the utmost confidence to its future career. . . We have every reason to feel assured of a further long and prosperous career, and, with an ample and more settled labour supply, we may look forward to even larger outputs and still higher dividends. . . On a capital of £500,000 (increased from £400,000 in 1902), the company has produced gold to the value of three and three-quarter millions, resulting in a profit of £1,836,000, out of which £1,200,000 has been paid to shareholders, and the greater part of the balance on development and plant. . . . These few figures mark the Van Ryn as a gold mining enterprise of exceptional standing, and, as far as it is possible to judge to-day, there is every reason, as I said before, to feel assured of a further long and prosperous career."

It is unnecessary to do more than glance at the following tabular statement of the returns from the Van Ryn for the past twelve months to perceive that the steady progress of the past has been successfully continued.

1911.	Stamps.	Tons Milled.	Recovery per ton Milled. s.	d.	Working Costs p. ton Milled. s.	d.	Profit per ton Milled. s.	d.	Total Profit.
July...	120	37,510	27	7	14	11	12	8	£23,634
August...	120	37,500	27	10	15	6	12	4	23,000
September ...	135	37,070	28	7	15	11	12	8	23,429
October	135	39,020	28	4	15	4	13	0	25,255
November... ...	135	36,680	28	4	15	4	13	0	24,385
December ...	135	39,510	27	4	14	10	12	6	25,041
1912.									
January	135	39,200	28	0	15	2	12	10	25,188
February	125	37,500	27	7	15	6	12	1	23,030
March...	125	39,700	27	11	15	3	12	8	25,051
April	125	38,650	26	7	14	11	11	9	22,513
May...	125	39,640	21	1	15	11	12	2	24,077
June	125	37,760	28	6	16	6	12	6	23,985
July	130	40,270	26	11	15	4	11	7	23,419

The question of ore reserves is one which must of necessity be discussed in considering the position of any mine, and it is gratifying to remember that at the end of the financial year ending June 30th, 1911, there were over a million and a half tons of payable ore developed, or more than a three years' supply, every ton of which had been paid for out of profits, so that working costs were then only charged with the actual cost of developing ore to replace the current crushing. The ore reserves at the end of the year ended June 30th, 1912, amounted to 2,000,000 tons, of a value of 6¼ dwts., or an increase of 400,000 tons on the previous year, without any diminution in values. A notable circumstance in connection with the calculated value of the reserves at the Van Ryn is that they have for long periods been exceeded by the value, a fact which indicates, as was pointed out at the last annual meeting, a conservative tendency on the valuation of the mine. The working profits for the past year, exclusive of sundry revenue, were £285,205. The annual report, giving full details, is expected to be issued shortly.

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[*Photo by Dittrich, Cairo*

HIS HIGHNESS THE KHEDIVE OF EGYPT, ABBAS HILMI PASHA

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The Consolidated Gold Fields Group

ROBINSON DEEP GOLD MINING CO., LTD.

Capital, in £1 shares £1,000,000
Number of Claims 215

Situated on the dip of the Robinson, Worcester and Ferreira Companies, on the Central Rand. The company also holds the freehold surface rights over about 30 acres.

Number of Stamps 300

And five Tube Mills.

DIRECTORS.

F. D. Chaplin (*Chairman*)	*alternate*	D. W. Rossiter.
W. Smits	,,	J. E. Kent.
W. Hume	,,	F. Leslie Brown.
C. Davis	,,	Major C. H. Mullins.
D. Christopherson	,,	R. Parnell.

LONDON COMMITTEE.

Leigh Hoskyns	*alternate*	A. P. B. Loftus.
Capt. E. H. R. Hibbert	,,	Lewis G. Hamilton.
H. Knatchbull-Hugessen	,,	Col. T. Harris.
H. D. Boyle	,,	Bento y Vieira.

GENERAL MANAGER.
J. J. Wessels.

CONSULTING ENGINEER.
H. H. Webb.

SECRETARIES AND OFFICES.
Consolidated Gold Fields of South Africa, Limited, Simmonds Street, Johannesburg.

PARIS AGENTS.
Consolidated Gold Fields of South Africa, Limited, 12, Rue des Pyramides.

LONDON AGENTS.
Consolidated Gold Fields of South Africa, Limited.

LONDON SECRETARY AND OFFICES.
J. T. Bedborough, 8, Old Jewry, E.C.

TURFFONTEIN ESTATE, LIMITED.

Capital, in £1 shares £50,000
Issued Capital ... ... all

The company owns an estate of about 4,000 acres, being the southern portion of the farm Turffontein, near Johannesburg (south). The company's revenue is derived from stand licences in the Turffontein Township, and from water-rights and leases.

DIRECTORS.
James C. Prinsep. T. J. Milner. H. C. Porter.

SECRETARY AND OFFICES.
A. E. Blanchard, 8, Old Jewry, E.C.

SIMMER AND JACK PROPRIETARY MINES, LTD.

Capital, in £1 shares £3,000,000

Property: 624 Claims, six Water-rights, and a Freehold Estate of about 2,675 acres, on which is the township of Germiston. Situated on the Central Rand, east of Johannesburg.

Number of Stamps 320

And seven Tube Mills.

DIRECTORS.

F. D. P. Chaplin (*Chairman*)	*alternate*	C. H. Barclay.
J. Durham	,,	D. W. Rossiter.
Major H. L. Sapte	,,	W. S. Smits.
W. Hume	,,	F. Leslie Brown.
D. Christopherson	,,	W. Sangster.

LONDON COMMITTEE.

C. D. Rudd	*alternate*	J. P. H. Dunsmure.
Capt. E. H. J. Hibbert.	,,	A. P. B. Loftus.
H. D. Boyle.		
Bento y Vieira.		

CONSULTING ENGINEER.
H. H. Webb.

SECRETARIES AND OFFICES.
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Consolidated Gold Fields of South Africa, Limited, 12, Rue des Pyramides.

LONDON AGENTS.
Consolidated Gold Fields of South Africa, Limited.

LONDON SECRETARY AND OFFICES.
J. T. Bedborough, 8, Old Jewry, E.C.

THE CONSOLIDATED GOLD FIELDS OF SOUTH AFRICA, LIMITED.

Capital: Ordinary shares £2,000,000
1st Preference shares £1,250,000
2nd Preference shares £1,250,000
Debentures outstanding £225,000
Reserve £2,000,000
Balance at credit of Profit and Loss Account, June 30, 1911 ... ... £466,488

The company has considerable claim holdings on the central and other sections of the Rand, largely deep level, as well as on other goldfields in the Transvaal. It has also very large interests and holdings of shares in its subsidiary and other companies in the Transvaal, as well as in Rhodesia, West Africa, etc.

DIRECTORS.
Lord Harris, *Chairman*.

E. Birkenruth.	Leigh Hoskyns.
S. Christopherson.	R. Maguire.
H. W. H. Dunsmure.	J. C. Prinsep.
Colonel E. Frewen.	Major H. L. Sapte.

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H. C. Porter, *Secretary*, London.
H. G. Sidgreaves, *Assistant Secretary*.
J. G. McDonald, *General Manager*, Rhodesia.
F. D. P. Chaplin, D. Christopherson, *Joint Managers*, Johannesburg.
E. C. Goodhart, *Manager*, Paris.
Baron A. von der Ropp, America.

ENGINEERING STAFF.
H. H. Webb, *Consulting Engineer*.
C. D. Leslie, *Superintending Engineer*, Transvaal.
H. A. Piper, *Consulting Engineer*, Rhodesia.

H. C. Behr.	A. J. Fraser.
Dr. W. A. Caldecott.	A. C. Holtby.
J. W. Craig.	A. E. Pettit.
W. F. H. Dudgeon.	G. H. Thurston.

LONDON OFFICE.
8, Old Jewry, E.C.

PARIS OFFICE.
12, Rue des Pyramides.

SIMMER AND JACK EAST, LIMITED.
(In Liquidation).

Capital, in £1 shares £700,000
Issued Capital £650,000
Number of Claims 325,830

Situated on the dip of the Rose Deep and Glen Deep Companies, East Central Rand.

Number of Stamps 200
And three Tube Mills.

TRUSTEES FOR 1ST DEBENTURE HOLDERS.
The Earl of Verulam. Lord Harris.

TRUSTEES FOR 2ND DEBENTURE HOLDERS.
The Earl of Chesterfield. E. J. Castle, K.C.

CONSULTING ENGINEER.
H. H. Webb.

GENERAL MANAGER.
F. Mervyn Smith.

SECRETARIES AND HEAD OFFICES.
Consolidated Gold Fields of South Africa, Limited, Simmonds Street, Johannesburg.

LONDON SECRETARY AND OFFICES.
J. T. Bedborough, 8, Old Jewry, E.C.

PARIS AGENTS.
Consolidated Gold Fields of South Africa, Limited, 12, Rue des Pyramides.

KNIGHTS DEEP, LIMITED.

Capital, in £1 shares £650,000
Issued Capital £643,526
Number of Claims 180.712
Situated on Farm Driefontein No. 12, East Rand.
Number of Stamps 200
and six Tube Mills.

TRUSTEES FOR DEBENTURE HOLDERS.
The Earl of Chesterfield. Hon. Eustace Fiennes.

DIRECTORS.

F. D. P. Chaplin (*Chairman*)	*alternate*	W. Sangster.
W. H. Dawe	,,	A. G. Gill.
D. Christopherson	,,	J. E. Kent.
E. A. Wallers	,,	Max Honnet.
E. Birkenruth	,,	F. Leslie Brown.

LONDON COMMITTEE.

Capt. E. H. R. Hibbert	*alternate*	L. G. Hamilton.
Col. T. Harris.	,,	Bento y Vieira.
H. D. Boyle		
A. P. B. Loftus.		

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G. A. Chalkley.

CONSULTING ENGINEER.
H. H. Webb.

LONDON SECRETARY AND OFFICE.
J. T. Bedborough, 8, Old Jewry, E.C.

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PARIS AGENTS.
Consolidated Gold Fields of South Africa, Limited, 12, Rue des Pyramides.

LONDON AGENTS.
Consolidated Gold Fields of South Africa, Limited.

THE SIMMER DEEP, LIMITED.

Capital, in £1 shares £1,750,000
Issued Capital £1,650,000
Number of Claims 1,035
Number of Stamps 200
And nine Tube Mills.

DIRECTORS.

F. D. P. Chaplin (*Chairman*).	*alternate*	W. Sangster.
D. Christopherson	,,	J. E. Kent.
E. Birkenruth	,,	F. Leslie Brown.
E. J. Renaud.	,,	J. Jourdan.
W. S. Smits	,,	D. W. Rossiter.

TRUSTEES FOR 1ST DEBENTURE HOLDERS.
S. Christopherson. K. McAlpine.

TRUSTEES FOR 2ND DEBENTURE HOLDERS.
Marquis d'Hautpoul. H. Knatchbull-Hugessen.

LONDON COMMITTEE.
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Capt. E. H. R. Hibbert. A. P. B. Loftus.

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H. S. Macgregor.

CONSULTING ENGINEER.
H. H. Webb.

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LONDON AGENTS.
Consolidated Gold Fields of South Africa, Limited.

LONDON SECRETARY AND OFFICES.
J. T. Bedborough, 8, Old Jewry, E.C.

PARIS AGENTS.
Consolidated Gold Fields of South Africa, Limited, 12, Rue des Pyramides.

GOLD MINES INVESTMENT COMPANY, LIMITED.

Capital, in £1 shares £1,500,000
Issued Capital £500,000

DIRECTORS.
J. Prinsep, Chairman.
Col. E. Frewen. R. Maguire.
L. Hoskyns. Major H. L. Sapte.
H. W. H. Dunsmure.

SECRETARY AND OFFICE.
H. G. Sidgreaves, 8, Old Jewry, E.C.

PARIS AGENTS.
Consolidated Gold Fields of South Africa, Limited, 12, Rue des Pyramides.

SUB-NIGEL, LIMITED.

Capital, in £1 shares £475,000
Issued Capital £431,580
Number of Claims 1,375
And four Water-rights.
Situated in the Heidelberg district and adjacent to the Nigel property.

DIRECTORS.

F. D. P. Chaplin (*Chairman*)	*alternate*	D. W. Rossiter.
D. Christopherson	,,	R. Parnell.
E. Turk	,,	J. A. Cohen.
J. H. Leslie.		
P. Dreyfus.		
W. Hume	,,	F. Leslie Brown.
W. S. Smits.	,,	J. E. Kent.

LONDON COMMITTEE.

A. Radford	*alternate*	H. D. Boyle.
L. Ehrlich.		
Col. T. Harris	,,	Bento y Vieira.
A. P. B. Loftus.		
Capt. E. H. R. Hibbert.		

GENERAL MANAGER.
J. S. Cellier.

CONSULTING ENGINEER.
H. H. Webb.

SECRETARIES AND OFFICES.
Consolidated Gold Fields of South Africa, Limited, Simmonds Street, Johannesburg.

PARIS AGENTS.
Consolidated Gold Fields of South Africa, Limited, 12, Rue des Pyramides.

LONDON SECRETARY AND OFFICES.
J. T. Bedborough, 8, Old Jewry, E.C.

JUPITER GOLD MINING COMPANY, LIMITED.

Capital, in £1 shares £1,032,000
Issued Capital £1,014,200
Number of Claims 499.771
Situated on the dip of the Jumpers Deep and Geldenhuis Deep, on the Central Rand.
Number of Stamps 100
And six Tube Mills.

DIRECTORS.

F. D. P. Chaplin (*Chairman*)	*alternate*	D. W. Rossiter.
W. S. Smits	,,	F. Leslie Brown.
C. Distel	,,	H. Eekstein.
E. A. Wallers	,,	M. Honnet.
H. C. Boyd	,,	C. Meintjes.
D. Christopherson	,,	J. E. Kent.

LONDON COMMITTEE.

Capt. E. H. R. Hibbert	*alternate*	Bento y Vieira.
A. Radford	,,	Col. T. Harris.
A. P. B. Loftus.		
H. D. Boyle.		

GENERAL MANAGER.
J. M. L. Henry.

CONSULTING ENGINEER.
H. H. Webb.

SECRETARIES.
The Consolidated Gold Fields of South Africa, Limited.

HEAD OFFICE.
Consolidated Gold Fields Buildings, Johannesburg.

LONDON SECRETARY AND OFFICES.
J. T. Bedborough, 8, Old Jewry, E.C.

PARIS AGENTS.
Consolidated Gold Fields of South Africa, Limited, 12, Rue des Pyramides.

LEADING MINES OF THE GOLD FIELDS GROUP.

ROBINSON DEEP G.M. COMPANY.

The history of the Robinson Deep mine is more or less typical of a Rand deep level mine. It has gone through numerous vicissitudes, has at times been the subject of unbounded optimism, and at others of unwarranted despondency. No one will pretend that the management of this mine has always been good; no one will deny that the present management are doing their very best to remedy the evils contracted in the earlier days of the company's existence, and to banish the undesirable legacies of insecure walls and shafts bequeathed by faulty mining in the earlier days of the company's existence. It is common knowledge that the Robinson Deep gained in the past a very unsavoury reputation amongst miners, both white and black, and numerous serious accidents, resulting in the loss of large numbers of lives, have occurred at the property.

		Stamps.	Tons Milled.	Sorting Per Cent.	Revenue. Amount. £	Revenue. Per Ton.	Expenses. Amount. £	Expenses. Per Ton.	Profit. Amount. £	Profit. Per Ton
Year to July 31,	1904	av. 100	178,903	—	275,223	30/ 9	266,047	29/ 9	9,176	1/ 0
Year to July 31,	1905	av. 125	242,950	18.9	391,808	32/ 3	337,842	27/10	53,966	4/ 5
Year to July 31,	1906	av. 110	270,569	21.4	401,422	29/ 8	324,439	24/ 0	76,983	5/ 8
Year to July, 31,	1907	av. 158	385,047	19¼	557,815	29/ 0	400,481	20/10	157,334	8/ 2
Year to July 31,	1908	av. 200	504,890	10¼	680,561	26/11	425,979	16/10	254,582	10/ 1
Year to July 31,	1909	av. 255	593,990	10½	710,372	23/11	429,066	14/ 5	281,306	9/ 6
Year to July 31,	1910	av. 270	650,820	9¼	684,334	21/ 0	399,030	12/ 3	285,304	8/ 9
Year to July 31.	1911	av. 268¼	695,670	5½	682,997	19/ 7	398,692	11/ 5	284,305	8/ 2
Quarter ending Oct.	1911	av. 270	188,320	—	167,430	17/ 9	102,291	10/10	65,139	6/11
Month ending Nov.	1911	av. 270	62,600	5.68	55,029	17/ 7	33,578	10/ 6	21,451	6/10
Month ending Dec.	1911	av. 270	61,950	6.07	54,320	17/ 6	34,071	10/ 9	20,249	6/ 6

A Much Better Position.

The situation underground has of late, however, been greatly improved. A large amount of timber has been lowered into the mine, "pigstys" have been erected, and waste packs have been built up to support the hanging. In addition to this, the east shaft has been retimbered, and many other improvements and alterations have been effected underground. This work has, of course, cost considerable sums of money, and further alterations and improvements will continue to be charged to the expenditure account for a few months more. This work will, however, be favourably reflected in the returns. The improvement in the affairs of the company may be directly traced to: (a) Better developments, particularly in the western section of the mine; and (b) improved working facilities underground, particularly in regard to the more efficient, economical and extensive use of machine drills for stoping purposes. Time was when the Robinson Deep was regarded as essentially a "hammerboy" mine. To-day only about two hundred hammer boys are on the company's books. In his report on the operations of the Robinson Deep during the twelve months ended with July, 1911, contained in the report of the Consolidated Gold Fields of South Africa, Ltd., Mr. C. D. Leslie remarked of the employment of machine drills for stoping purposes: "An average of 223 less natives were employed during the year, but, on the other hand, 16,918 fathoms were stoped by means of small machines as against 2,843 fathoms during the previous year. During the month of July of this year 623 fathoms were broken by hammer boys over an average stoping width of 53.8 inches, and 1,591 fathoms by means of small machines over an average stoping width of 56.2 inches, small machines having operated at a reduction of 1s. 6.7d. per ton broken, as compared with hammer boys, which demonstrates practically that the initial difficulties experienced with small machines have to a great extent been overcome at this mine. Accordingly a new 50-drill electrically driven air compressor is being installed, so as to increase the number of small machines which can be used for stoping purposes." The next annual report of the company will reflect the benefits secured by an extension of this machine drilling policy in a much greater degree. In the Robinson Deep special attention has been given the subject of stoping by means of small machine drills, and the efficiency has been brought up to a very high standard. Indeed, the large amount of ground broken per machine shift is now as high as .8 of a fathom or even more, a result on which the management are certainly entitled to congratulations.

Labour Shortage.

It is an old saying that necessity is the mother of invention, and it would appear that in the case of the Robinson Deep necessity has been the remaking of this notorious and prosperous mine—the first deep-deep level proposition to commence productive operations on the Witwatersrand. To-day the labour complement of the company is less than 3,000, whereas the full labour force necessary has been placed at 5,000, and certainly not less than 3,800 natives are required to run the mine to the best advantage. Notwithstanding this shortage, however, the company is securing satisfactory results.

The Future.

The outlook for the future is promising. Although hampered by labour shortage, the extended employment of small machine drills has been put to such good purpose that the mine is practically independent of hammer boys. The general condition of the property as regards security of working has been greatly improved of recent months, and both in the eastern and western sections of the property development values are satisfactory. In this western section of the property a large extent of valuable ground remains to be exploited. Taken altogether, the position of the Robinson Deep to-day is quite satisfactory, despite the shortage of labour.

THE KNIGHTS DEEP, LTD.

The Knights Deep with working costs at 10s. 9d. per ton records a lower rate of operating expenditure than any other proposition on the Witwatersrand. Because of its low grade nature it is absolutely imperative that working expenses should prevail at a very low rate. When the company commenced milling a grade of over 30s. per ton was obtained, the recovery during the second year of the company's productive existence—year ended July 31, 1905—being 32s. 3d. per ton. Expenses during that period came to 27s. 10d. per ton. Year by year the recovery per ton has fallen and with a view to at least maintaining profits the management has exerted every endeavour to increase the tonnage milled and reduce working expenditure. Of course large tonnages of ore have become of profitable value in consequence of this policy, and it is obvious from the ore reserves and the general underground position that the company will be able to maintain the grade of ore it is at present working.

Some Important Statistics.

The history of this mine and its outstanding characteristics are so clearly defined by the records of the various years' work that we here reproduce the salient features of the eight annual reports of the company. These are supplemented by quarterly and monthly statements.

Large Tonnage Imperative.

We have, on certain occasions, disputed the wisdom of the big mill policy, and the strenuous endeavours for a maximum of ore crushed, and a minimum of money expended, contending that such methods are not often consistent with a maximum of profit. But each mine must be considered on its own individual peculiarities, and in the case of the Knights Deep it is clear that a low rate of cost and therefore a large basis of production are absolutely necessary. An examination of the assay plan of the mine shows that very few of the stopes are of over 6 or 7 dwts. value, in fact the normal recovery of the mine to-day is but little over 4 dwts. per ton. To-day the Knights Deep is essentially a low grade venture, with large stopes, and very busy shafts and the lowest rate of expenditure on the Witwatersrand Gold Fields. To instance the size of some of the workings reference may be made to the bottom stope in the mine, which is probably the largest on the Witwatersrand, 24 machines being at work there, and the reef assaying about 6 dwts. per ton on a milling width of 7 feet. Tonnage, as already stated, is a great consideration in the case of a mine like the Knights Deep. About 75 per cent. of the ore sent to surface through the Robertson and Connor shafts to-day is derived from machines, and 25 per cent. by reclamation. Underground, large pig-styes and waste packs are built. The mining expenses as disclosed in the last quarterly report were at the rate of 5s. 11.34d. per ton, and pumping costs at slightly over 2d. per ton—the water pumped by the company has decreased greatly of recent years.

Life and Ore Reserves.

The Knights Deep "life," although no claim is advanced for anything but a very approximate estimate, may be calculated at about fifteen years from this date. The ore developed in the mine at the end of July, 1911, was estimated at some 1,650,000 payable tons of fully developed milling ore of an average assay value of 5.2 dwts., and in addition there were some 57,000 tons of partially developed ore of an estimated value of 4.55 dwts. Exclusive of this reserve tonnage, there were large areas in which sufficient work had been done to admit of the ground being attacked by stoping, but which had not been included in the reserve owing to the absence of reliable information as regards value. No account was taken in this estimate of the tonnage likely to be milled from the Bastard Reef, as this ore body has proved to be too changeable in value to permit of an estimation, although little doubt exists that a considerable tonnage from this reef will be mined at a profit. In writing of the Bastard Reef in his last annual report, Mr. C. D. Leslie, the superintending engineer, remarked:—"This reef, which was mined cheaply and with considerable success during the past year, would with reduced working costs become a more valuable source of ore supply by means of which the profitable life of the mine would be materially extended." In connection with these facts and figures it is important to note that operating costs are to-day ruling at approximately one shilling less than the average for last year. The ore reserves stand to-day substantially higher than they did at the end of July last.

SIMMER DEEP, LIMITED.

A Low Grade Deeper Level—Important Ventilation Schemes—Encouraging Results from Hammer Drills—General Outlook.

The Simmer Deep—an amalgamation of "Gold Fields" deep level properties lying on the dip of the Simmer and Jack Proprietary, and embracing a total area of 1,035 claims—is a typical deeper level Rand mine of rather under average ore gfade. It is notorious that managers of propositions of this nature have had a veritable path of thorns to tread during the last year or two when additional burdens of taxation have been constantly threatened or actually imposed, and when native labour recruiting charges have been continually increasing.

Importance of Low Costs.

Accordingly, the prosperity of this company is largely wrapped up in the question of working costs. The Jupiter, a sister mine adjoining the Simmer Deep on the west, is in a similar

position. These two companies possess a joint plant of 108,000 tons per month capacity—three hundred stamps and fifteen tube mills, the proportions at present being Simmer Deep one hundred and eighty stamps and nine tube mills, and Jupiter one hundred and twenty stamps and six tube mills. In order to reduce costs—a most necessary achievement at the Simmer Deep—operations on as large a basis as possible is imperative. But for various reasons the company has not as yet been able to utilise its large equipment to full capacity.

The Ventilating Scheme.

With a view to lowering costs and increasing the small margin of profit which the Simmer Deep ore admits of being earned, every endeavour has been exercised in the direction of improving underground labouring efficiency. Special attention, therefore, has been accorded the question of ventilation. The Simmer Deep is, as a matter of fact, one of the deepest mines on the Rand, a maximum vertical depth of just under five thousand feet having been attained. There are three shafts—the Milner or West shaft, the Rudd or Central shaft, and the Clement or Eastern, situated on the borders of the township of Germiston. The Milner and the Clement are used for hoisting men and ore, the Rudd being employed solely as a water and ventilation shaft. A large Sirocco fan has been installed at the Rudd. This shaft can be sealed over, and is the central and chief point in the admirable ventilation scheme which has been carried out at the Simmer Deep, and which has so greatly improved the underground working conditions. The Milner and Clement are downcast shafts and the air descending is "split" into five currents, which travel throughout the workings. In the Milner the air is confined within the shaft area by means of doors and is carried down to the 21st level. By means of doors and bratticing the air is here divided into two portions, one volume ventilating the stopes and drives, etc., to the west of this shaft, that is to say, towards the Jupiter boundary, the other portion travelling eastwards and, of course, upwards. In the Clement section there are three air "splits." A certain amount of the air is led off at the seventh level to serve the upper workings of the mine. The remainder travels to the sixteenth level, where it is split into two currents, one ventilating the eastern portion and the other the western. Particular attention has been given to the allaying of dust, and sprays are in use throughout the workings. To ensure the delivery of a sufficient supply of water, three dams have been constructed underground. One of these is of 26,300 gallons capacity, another 13,550, and the third of 9,000 gallons capacity.

Development, Ore Reserves and Stoping.

Since the date of the last report there has not been any very marked or noticeable change in the development position, and the ore reserves stand approximately the same, both in regard to tonnage and value as at the end of last year, viz., 1,312,000 tons of 4.9 dwts. average assay. The most important development work being undertaken at present is on the twenty-first level going west from the Milner. This is being pushed ahead with a view to effecting connection at this point with the Jupiter. The Simmer Deep and Jupiter mines are, it may here be remarked, joined up on the 14th level. As regards stoping operations, reference must be made to the extensive use of machine drills. In a mine such as the Simmer Deep where the margin of profit is exceedingly small, tonnage is a most vital consideration, and in the absence of a sufficiency of native labour much depends on achievements with small drills. Success is anticipated from the employment of hammer drills in particular. Some weeks ago ten of these machines were started up in the Simmer Deep, and the results secured have been wholly gratifying. There is very little reclamation work to be carried out at the Simmer Deep—in contradistinction to the Knights Deep—and it is clear that in this property hammer drills will have to be adapted to the stope faces. They are also being employed on winzing work.

The Equipment.

The Simmer Deep is a large property with shafts distributed over a huge area, a circumstance which does not tend to a low rate of expenditure, despite the fact that the means of transporting ore to the mill—by means of steam locomotives—is cheap and efficient. The three hundred stamps in the joint Simmer Deep—Jupiter battery are now running at ninety-five drops per minute and crushing through a sixteen-mesh, the duty being about thirteen and a half tons per head per diem. There are fifteen standard twenty-two feet six inch tube mills arranged in parallel, this constituting the longest line of tube mills employed on the Rand. All plates are now stationary and are situated in the tube mill house, shaking tables having been done away with. Previous to this change the amalgamating area was 6,801 square feet, but to-day this amounts to only 2,842 feet. Caldecott tables and cones form a prominent feature in this plant. There are two tables of twenty feet diameter with a two feet six inches filter bed and one of twenty-five feet diameter with a three feet filter bed To each table there are four primary and two washing cones.

Finances and General Outlook.

The balance sheet presented to shareholders at the last annual meeting—in March—showed a balance to credit of working expenditure and revenue account at December 31st, 1911, amounting to £53,838. The financial resources of the company, so far as can be estimated at present, are sufficient to meet all debenture obligations for the next two years. It is hoped, with some reason, that within that period the mine will be placed on a more satisfactory profit-earning basis. The area, over one thousand claims, is vast, and a huge amount of development of course remains to be carried out. Any estimate as to life must necessarily be a mere approximation, and in these circumstances a forecast as to the life of the mine is too problematical an affair to give expression to. It is, however, certain that the Simmer Deep and its sister mine, the Jupiter, have ore contents sufficiently great to enable them to carry on productive operations for many years to come.

THE SUB NIGEL, LIMITED.

The working expenditure and revenue account of the Sub Nigel for the year ended June 30, 1912, shows that the profit from operations for the year amounted to £3,828; interest, dividends on investments and sundry revenue received, less interest paid, brought in £4,644. The amounts written off for depreciation, etc., were £265. Deducting amount at debit of appropriation account at 30th June, 1911 (£6,664), the amount at credit of appropriation account at 30th June, 1912, is £1,543.

Mr. J. W. Craig, acting superintending engineer, writes:—"An ore reserve estimate, compiled from data which can hardly be considered sufficient for an accurate determination owing to characteristic fluctuations in reef values in this district, shows that there are fully developed some 85,000 tons of payable ore valued at 8.9 dwts., and in addition there are indicated some 25,000 tons of partially developed ore, averaging 9.7 dwts., contained in areas in which no stoping can take place until further development work has been done. Disclosures from this work will determine the proportion of this partially developed ore which should be classified as payable.

"The development of this mine has been much retarded during late years by the complications introduced by a series of intersecting dykes. After considerable work had been done the down-thrown reef was definitely located below the bottoms of both "D" and "E" shafts. In order to negotiate the serious vertical downthrow of 330 feet, the incline at "D" shaft was steepened and sunk to the reef, where considerable development has been done below the dyke with satisfactory results, the details of which you will find in the manager's report. In "E" shaft it was necessary to widen the existing incline before turning to the steeper angle: this work is practically finished, and active sinking will be started at once. When the reef is intersected here it will be possible to carry out a more ambitious plan of development in the large unexplored areas of the mine."

THE YEAR WITH THE SIMMER AND JACK.

Working Profit, £529,944—Strong Position of Ore Reserves—Sand-filling Advantages.

The working profit earned by the Simmer and Jack for the year ended 30th June, 1912, after allowing for the expenditure of £2,070 19s. 4d. on renewals and replacements of machinery, plant, buildings, etc., amounted to £529,944; sundry revenue amounted to £33,247; making a total of £563,191. The estimated profits tax, French Government duty and stamps, and amounts written off were £51,836. The amount credited to appropriation account was, therefore, £511,355, which, with a balance at credit of appropriation account at 30th June, 1911, of £80,104, made up £591,460. The amounts appropriated for dividends Nos. 19 and 20 of 7½ per cent. each, declared during the year, were £450,000. The amount set aside as a further provision for additions to and renewals of machinery and plant was £22,500; less £2,070 expended on renewals and replacements of machinery and plant and charged to working costs, thus leaving a balance at credit of appropriation account at 30th June, 1912, of £121,031.

Mr. J. W. Craig, the acting superintending engineer, writes: The ore reserves at 30th June last are estimated at some 2,680,000 fully developed payable milling tons of an average assay value of 6.2 dwts. per ton, in addition to which there are some 438,000 tons of partially developed ore of an estimated average value of 5.3 dwts. Besides this reserve, there is a considerable tonnage available for stoping from the upper levels, and from foot and hanging walls of old stopes, which will be credited to the ore reserves as the ore is mined. Sand-filling of worked-out areas has been so successfully carried out on a comparatively small scale during the past two years that it has been decided to extend the system. To this end plant is now in course of erection, which will render it possible to lower into the old workings about one-half of the sand produced by the reduction plant. In addition to the great advantages of safer working and more efficient control of underground ventilation, it is expected that this system will result in actual increase of profit through reduction in costs and the recovery of good ore now unavoidably left as pillars.

Manager's Report.

Mr. O. P. Powell, the manager, writes, *inter alia*:—Crushing.—Average number of stamps running 320, tons mined 922,624, stoped and developed 528,828, reclamation 393,796, percentage of waste sorted out 7.15, tons milled 863,500, days milling 356.182, tons milled per stamp per day 7.45, average number tube mills working 7, days milling 350.439. The development footage for the year was 4,566 feet, as per summary:—Driving 1.474½, raising 813½, winzing 1,020, cross-cutting 1,258; total, 4,566 feet. Shaft Sinking.—During the year shaft sinking was done as follows: No. 2 Auxiliary Incline Shaft, 90 feet. Details of Working Expenses.—Mining expenses, £305,078 3s. 5d., cost per ton milled 7s. 0.794d.; development, £12,334 15s. 9d., cost per ton milled 3.428d.; transport of ore and sorting and crushing £17,456 17s. 4d., cost per ton milled 4.852d.; milling £41,067 11s. 8d., cost per ton milled 11.414d.; tube milling £26,776 4s. 8d., cost per ton milled 7.442d.; sand expenses £42,139 14s., cost per ton milled 11.712d.; slimes expenses £20.852 19s. 10d., cost per ton milled 5.796d.; general charges £43,744 3s. 5d., cost per ton milled 1s. 0.158d.; expenditure on renewals and replacements of machinery and plant £2,070 19s. 4d., cost per ton milled .576d.; total amount £511,521 9s. 5d., total cost per ton milled 11s. 10.172d. Ore Reserves.—The estimate of payable milling ore developed at 30th June, 1912, is 2,680,000 tons of an average of 6.2 dwts. Plant.—During the year the following additions and improvements were made to the plant:—A magnetic separator was installed in the tube mill circuit; the slimes plant was increased by two 70 feet treatment vats and one 50 feet collecting vat with neeessary piping, launders, etc.; runways were installed in the workshops; the pebble bin at the mill was extended; alterations in respect of circulating slime pulp were effected. Sand Filling.—During the past two years, current sand residues have been lowered into the mine for the purpose of filling worked-out areas, and permitting the removal of ore left as pillars, etc. The underground conditions at the mine being particularly favourable for economic carrying out of these operations, it has been decided to re-arrange and enlarge the existing plant, and a new borehole has been sunk to a depth of 527 feet and an old disused shaft brought into commission for the lowering of the sand. That portion of the worked-out area lying under the railway is being filled in on instructions received from the Mines Department.

The Goerz Group

A. GOERZ AND COMPANY, LIMITED.

(Incorporated in the Transvaal.)

Capital, in £1 Shares	£1,400,000
Authorised Capital	£1,500,000
Registered Capital	£1,400,000
Issued Capital	£1,400,000

Interests and Holdings.—The Company has large share interests in the companies included in the Goerz Group, and holdings in many other concerns. At the end of 1910 the Company held 635 claims, most of them being well-situated deep-level blocks in the western district of the Rand, and its land holdings consisted of 10,740 acres of unproclaimed deep-level ground in this district. There are also other important interests on the Rand and in Mexico.

DIRECTORS.

Amandus Brakhan, *Chairman.*
Henry Strakosch *alternate* W. Mc.Cameron.
(*Managing Director*)
O. Braunfels.
Count Jean d'Ayguesvives.
Paul Mankiewitz ,, H. Neuhaus.
Sir Carl Meyer, Bart. ,, M. G. Elkan.
James Zutrauen.
M. Steinthal ,, M. Friedlander.

GENERAL STAFF.

Johannesburg:
M. G. Elkan, } (*Joint Managers*).
H. Neuhaus, }
V. J. Ronketti, *Secretary.*

London:
Henry Strakosch (*Managing Director*).
Joseph Kitchin (*Manager*).
R. Valentin, } (*Joint Sub-Managers*).
E. J. Hess, }
Henry Clark, F.C.I.S. (*Secretary*).

Berlin:
M. Friedlander (*Manager*).
C. Schubert (*Sub-Manager.*)
Paris: M. Tourret (*Agent*).
Mexico City: C. T. Pott (*Sub-Manager*).

ENGINEERING STAFF.

W. McC. Cameron. H. R. Hill.
Edw. Coppée Thurston. Karl F. Hoffmann.
W. J. Cruddas. G. D. Stollreither.

OFFICES.

Johannesburg: Silesia Buildings (P.O. Box 1156).
London: Pinners Hall, Austin Friars, E.C.
Berlin: 29/32, Mauerstrasse.
Paris: 25, Rue de Clichy.
Mexico City: 1A, de Nuevo Mexico 6.

LANCASTER WEST GOLD MINING COMPANY, LIMITED.

(Registered under the Limited Liability Laws of the Transvaal.)

Authorised Capital	£850,000
Registered Capital	£700,000
Issued Capital	£590,250
Reserve Shares	109,750
Debenture Issue	£98,780
Number of Claims	582
Situated on the western section of the Rand.	
Number of Stamps	100
And 3 Tube Mills.	

DIRECTORS.

A. Brakhan *alternate* V. J. Ronketti.
(*Chairman*)
H. Neuhaus .. G. D. Stollreither.
(*Acting Chairman*)
Clement Davies ,, W. A. Nellist.
H. A. Barsdorf .. F. Elkan.
W. Dalrymple
E. J. Renaud .. J. Jourdan.
M. Francke ,, M. G. Elkan.

HEAD OFFICE.

Silesia Buildings, Johannesburg.
SECRETARY: W. M. Tudhope.

LONDON COMMITTEE.
J. Kitchin.
E. J. Hess.
R. Valentin.

BERLIN COMMITTEE.
A. Blinzig.
Dr. Hans Schultz.
M. Friedlaender.

LONDON OFFICE.

H. Rogers, Pinners Hall, Austin Friars, E.C.

BERLIN OFFICE.

Deutsche Treuhand-Gesellschaft, 17-20, Kanonier Strasse.

PARIS AGENT.

M. Tourret, 25 Rue de Clichy.

MAY CONSOLIDATED GOLD MINING COMPANY, LIMITED

(Registered under the Limited Liability Laws of the Transvaal.)

Capital, in £1 Shares	£290,000
Shares in Reserve	1,250
Number of Reef Claims	45
Situated on the East Central Rand, between the New Primrose and Glencairn Companies.	
Number of Stamps	100

DIRECTORS.

A. Brakhan *alternate* M. G. Elkan.
(*Chairman*)
H. Neuhaus (*Acting Chairman*)
M. Francke .. V. J. Ronketti
S. B. Joel .. J. Munro.
J. Friedlander ,, H. W. Anderson.
W. Dalrymple
W. Ross .. A. Aiken.
F. G. C. E. Robellaz ,, E. J. Renaud.
GENERAL MANAGER: K. K. H. Sartorius.

HEAD OFFICE.

Silesia Buildings, Johannesburg.
SECRETARY: W. M. Tudhope.

LONDON AGENCY.

Pinners Hall, Austin Friars, E.C.

LONDON COMMITTEE.

Sir H. Kimber, Bart, M.P., George H. Raw, A. Brakhan.
SECRETARY TO LONDON COMMITTEE: H. Rogers.

BERLIN SECRETARIES.

Deutsche Treuhand-Gesellschaft, 17-20, Kanonier Strasse, Berlin,

BERLIN COMMITTEE.

Dr. Hans Schultz, A. Blinzig, M. Friedlaender.

PARIS AGENT.

M. Tourret, 25, Rue de Clichy.

VAN DYK PROPRIETARY MINES, LIMITED.

(Registered under the Limited Liability Laws of the Transvaal.)

Authorised Capital	£850,000
Registered Capital, in £1 Shares	£650,000
Issued Capital	£500,000
Leaving 150,000 shares in reserve, of which 60,000 are under option to Messrs. A. Goerz and Co., Ltd., at 22s. 6d. per share.	

DIRECTORS.

A. Brakhan (*Chairman*) *alternate* V. J. Ronketti.
H. Neuhaus (*Acting Chairman*) ,, G. D. Stollreither
M. G. Elkan. .. M. Rode.
Clement Davies .. W. A. Nellist
Julius Friedlander ,, H. W. Anderson.

HEAD OFFICE.

Silesia Buildings, Johannesburg.
SECRETARY: W. M. Tudhope.

LONDON COMMITTEE.

J. Kitchin, E. J. Hess, R. Valentin.

LONDON OFFICE.

H. Rogers, Pinners Hall, Austin Friars, E.C.

BERLIN OFFICE.

Deutsche Treuhand-Gesellschaft, 17-20, Kanonier Strasse.

PARIS AGENT.

M. Tourret, 25, Rue de Clichy.

GEDULD PROPRIETARY MINES, LIMITED.

(Registered under the Limited Liability Laws of the Transvaal.)

Authorised Capital £1,000,000
Issued Capital, in £1 Shares £875,000
Property.—Farm Geduld No. 24, of which the Company owns the freehold, in extent about 8,475 acres, on which mining rights to the extent of 2,481 claims have been granted.
Situated on the eastern extension of the Rand.

DIRECTORS.

M. G. Elkan (*Chairman*)	*alternate*	H. Strakosch
M. Francke	,,	H. Neuhaus.
R. Heymann.	,,	O. Heymann.
Samuel Marks	,,	G. Falcke.
Clement Davies	,,	W. A. Nellist.
F. Elkan	,,	H. A. Barsdorf.
F. R. Lynch	,,	A. S. Pearse.

GENERAL MANAGER: L. A. Womble.
HEAD OFFICE.
Silesia Buildings, Johannesburg.
SECRETARY: W. M. Tudhope.
LONDON COMMITTEE.
J. Friedlander, E. Kennedy, A. Brakhan, F. W. Green.
BERLIN COMMITTEE.
M. Friedlaender, A. Blinzig, Dr. Hans Schultz.
LONDON OFFICE.
H. Rogers, Pinners Hall, Austin Friars, E.C.
BERLIN OFFICE.
Deutsche Treuhand-Gesellschaft, 17-20, Kanonier Strasse.
PARIS AGENT.
M. Tourret, 25, Rue de Clichy.

THE TUDOR GOLD MINING COMPANY, LIMITED.

(Registered under the Limited Liability Laws of the Transvaal.)

Registered Capital, in £1 Shares £400,000
Issued Capital £340,000
Reserve Shares 60,000
Number of Claims 261
Situated on the farms Witpoortje No. 44, Luipaardsvlei No. 8, in the Krugersdorp district, Witwatersrand Goldfields.

DIRECTORS.

A. Brakhan (*Chairman*)	*alternate*	H. Neuhaus.
M. G. Elkan (*Acting Chairman*)	,,	V. J. Ronketti.
S. C. Black	,,	B. Moses.
Julius Friedlander	,,	G. C. Fitzpatrick.

SECRETARY AND OFFICES.
W. M. Tudhope, Silesia Buildings, Johannesburg, P.O. Box 1125.
LONDON COMMITTEE.
Wm. Dettelbach, Julius Friedlander, Joseph Kitchin.
BERLIN COMMITTEE.
M. Friedlaender, A. Blinzig, Dr. Hans Schultz.
LONDON SECRETARY AND OFFICES.
Henry Rogers, Pinners Hall, Austin Friars, E.C.
BERLIN OFFICE.
Deutsche Treuhand-Gesellschaft, 17-20, Kanonier Strasse.
PARIS AGENT.
M. Tourret, 25, Rue de Clichy.

ROODEPOORT CENTRAL DEEP, LIMITED.

(Registered under the Limited Liability Laws of the Transvaal.)

In Liquidation.
Absorbed by Princess Estate and Gold Mining Co., Ltd.

LANCASTER GOLD MINING COMPANY, LIMITED.

(Registered under the Limited Liability Laws of the Transvaal.)

In Liquidation.
Absorbed by Lancaster West Gold Mining Co., Limited.

KLERKSDORP EXPLORATION, LAND AND ESTATE COMPANY LIMITED.

(Registered under the Limited Liability Laws of the Transvaal.)

Capital, in £1 Shares... ... ... £275,000
Issued Capital £196,667
Property.—The Company owns a number of farms and portions of farms in the Potchefstroom district of the Transvaal.

DIRECTORS.

Clement Davies	*alternate*	Raymond Des Clayes.
H. Neuhaus	,,	M. G. Elkan.
V. J. Ronketti		

SECRETARIES AND OFFICES.
South African and General Investment and Trust Co.,Ltd., Trust Buildings, Johannesburg, P.O. Box 155.

THE MODDERFONTEIN DEEP LEVELS, LIMITED.

(Registered under the Limited Liability Laws of the Transvaal.)

Authorised Capital £500,000
Registered Capital (all issued), in £1 Shares £263,000
Number of Claims 377¼
Situated on the farm Modderfontein No. 17, East Rand, on the immediate dip of the New Modderfontein Company's property.

DIRECTORS.

H. Neuhaus (*Chairman*)	*alternate*	G. D. Stollreither.
Gordon Sandilands.	,,	F. E. Elkan.
M. G. Elkan	,,	M. Rode.
Emrys Evans, C.M.G.	,,	A. Aiken.
A. Brakhan	,,	V. J. Ronketti.
F. R. Lynch	,,	A. S. Pearse.

HEAD OFFICE.
Silesia Buildings, Johannesburg, P.O. Box 1125.
SECRETARY: W. M. Tudhope.
LONDON COMMITTEE.
R. Valentin, David Powell, E. J. Hess.
BERLIN COMMITTEE.
M. Friedlaender, A. Blinzig, Dr. Hans Schultz.
LONDON OFFICE.
H. Rogers, Pinners Hall, Austin Friars, E.C.
BERLIN OFFICE.
Deutsche Treuhand-Gesellschaft, 17-20, Kanonier Strasse.
PARIS AGENT.
M. Tourret, 25, Rue de Clichy.

PRINCESS ESTATE AND GOLD MINING CO., LTD.

(Registered under the Limited Liability Laws of the Transvaal.)

Authorised Capital, in £1 Shares £650,000
Registered Capital (all issued) £575,033
Property.—Freehold of portion of farm Roodepoort, No. 43, in extent about 3,337 acres; a mining area equal to about 680 claims, partly on Roodepoort, No. 43, and partly on Witpoortje, No. 44, and Water Rights on these two farms, covering an area of about 497 acres. Number of stamps 60, and 5 tube mills.

DIRECTORS.

M. G. Elkan (*Chairman*)	*alternate*	M. Rode.
J. Friedlander	,,	H. W. Anderson.
G. Sonn	,,	F. Elkan.
H. Neuhaus.	,,	G. D. Stollreither.
Clement Davies	,,	W. A. Nellist.
J. H. Ryan.	,,	B. Southwell.
A. Brakhan	,,	V. J. Ronketti.
F. G. C. E. Robellaz	,,	E. J. Renaud.

HEAD OFFICE.
Silesia Buildings, Johannesburg, P.O. Box 1125.
SECRETARY: W. M. Tudhope.

LONDON COMMITTEE.	BERLIN COMMITTEE.
Albert Hess.	M. Friedlaender.
A. Brakhan.	Dr. Hans Schultz.
E. J. Hess.	A. Blinzig.

LONDON OFFICE.
H. Rogers, Pinners Hall, Austin Friars, E.C.
BERLIN OFFICE.
Deutsche Treuhand-Gesellschaft, 17-20, Kanonier Strasse,
PARIS AGENT.
M. Tourret, 25, Rue de Clichy.

LEADING MINES OF THE GOERZ GROUP.

THE GEDULD'S NEW PROGRAMME AND POLICY.

ALLOCATION OF THE INCREASED CAPITAL—FINANCIAL DETAILS—EXCELLENT PROSPECTS—FEATURES OF THE NEW PLANT.

In August of last year the shareholders of the Geduld Proprietary Mines sanctioned an increase in the capital of the company from £750,000, all of which is issued, to £1,000,000, by the creation of 250,000 shares of £1 each, which were placed at the disposal of the Board of Directors. At the meeting then held the Chairman pointed out that, in the first instance, the money to be obtained by the disposal of these new shares or a portion thereof would be used for the purpose of increasing the capacity of the reduction works, which amounts at present to only about 14,000 tons per month, and that this enlargement would be taken in hand as soon as the payable ore reserves warranted the taking of this step. Recent developments have been particularly encouraging, and on the strength thereof the company has issued 125,000 shares at par *pro rata* to shareholders to their present holdings, namely, one new share for every six held. This issue has been guaranteed free of commission by Messrs. A. Goerz and Co., Ltd., who, by way of consideration for such guarantee, have been given an option over 100,000 shares at 25s. per share until the 8th June, 1914. The issue was most successful.

It is pointed out by the Board that the development carried out during the first four months of this year has been of a particularly encouraging nature. During that period 4,670 feet have been driven, and the values disclosed are highly satisfactory. These development operations have not been confined to those portions of the mining area lying north and South of the No. 2 shaft, where previously work was principally carried on, but the new area situated to the east of the same shaft—which has been opened up by a long incline therefrom has received special attention, with excellent results. In this last-mentioned neighbourhood, of the 1,582 feet so far driven on the strike of the reef, 1,440 feet have been sampled which show an average value of 44s. over a milling width of 40 inches, while of the 618 feet of raises and winzes set off from this horizon, 525 feet sampled disclose an average value of even 45s. 9d. over the same width. The indications that the further opening up of the mine will continue to be equally favourable are distinctly encouraging, and under these circumstances the directors have decided forthwith to increase the crushing capacity of the plant to 24,000 tons per month. This will call for an expenditure of about £83,000, and during the construction period the profits earned as well as the balance of the money now to be provided by the share issue—roughly £42,000—will be used for deepening the incline shaft and to push development ahead with all possible speed. Orders for the new plant are now being placed, and it is expected that it will be in full working order in about twelve months' time.

Leaving alone that, in view of the very favourable development results now being obtained, it is considered possible that

the redemption charge may be reduced within a comparatively short period, it is confidently anticipated to materially reduce the working costs when the company is crushing 24,000 tons per month. The working costs during 1911 averaged 21s. 8.5d. per ton milled, while, including a development redemption charge of 4s. 6d. per ton milled, and without taking into account any possible reduction in this latter item, there is every reason to expect that they will be decreased to 20s. per ton milled at least, provided, of course, general conditions remain unchanged, and this should soon place the company in the ranks of our dividend-paying mines.

The New Reduction Plant.

The reduction plant on this mine will be increased during the next twelve months from its present capacity of 168,000 tons per annum to a capacity of 288,000 tons per annum. This increase involves the mining of about 30,000 tons per month, allowing for discarded waste, or about 1,200 tons per day, all of which will be hoisted through No. 2 shaft, in the neighbourhood of which the reduction plant is situated. The increase in capacity will be obtained by adding ten stamps of 1,650lbs. weight and three tube mills, each 5ft. 6in. by 22ft., with three stationary amalgamation plates per tube mill. This will bring the crushing plant up to a total of sixty heavy stamps and five tube mills. The amalgamation plates now in front of the stamps will be removed, as coarse crushing (through screens having nine holes per square inch) would cause scouring of such plates, and twenty short plates will be put in the circuit between the tube mill classification cones and the cyanide works. The pump house for elevating mill pulp will be removed, the present plunger pumps discarded, and centrifugal pumps installed. It is intended to produce 60 per cent. of slime and 40 per cent. of sand, the two products being separated by Caldecott cones, and the sand collected on two 15ft. Caldecott tables, which are to be installed. The treatment capacity of the sands plant will be obtained by converting the present collecting tanks into treatment tanks. The present decantation system for treating slime will be discontinued and be replaced by an air lift agitation plant for dissolving the gold, and Butters' filter plant for separating gold-bearing solution from slime. For this purpose four Brown tanks, each 15ft. by 45ft. high. will be installed, together with a filter plant containing 190 Butters' vacuum filter leaves, all of the existing slimes tanks being used in connection with the altered plant as collectors, storage and solution tanks. The reason for altering the system of slime treatment is the increased extraction which can be obtained. The laboratory plant has shown that on Geduld slime a reduction of .175 dwt., or 9d. per ton, in slime residue can be effected. The slimes plant will have a capacity of 15,000 tons per month. The hoisting plant will be equipped with six-ton skips, for the accommodation of which, and for the increased bin capacity, alterations in the headgear will be required, and better arrangements for washing the ore before going over the sorting belts will also be provided. The additional power needed for the enlarged plant will be obtained by the installation of an 800 k.w. mixed pressure steam turbine, utilising the exhaust steam from hauling engines and air compressors. Additional cottages for mine employees will be erected, the native compound enlarged to accommodate 850 additional boys, the hospital accommodation increased, and an isolation ward provided. The re-arrangement of the reduction plant is being effected in such a manner that it will be an easy matter to add on further units whenever it is decided to further increase the crushing capacity.

Underground.

The main north and south drives from No. 2 shaft, which have a total length of 8,350 feet, are equipped for hauling rock with electric locomotives. This level will control all the ore lying to the west of and on the dip of the reef above No. shaft, the ore being collected in subsidiary levels and gravitated through raises to this main haulage level. The main incline opening up the reef on the dip below No. 2 shaft, starting from the main station, has been carried eastwards a distance of 3,240 feet, and will be advanced immediately a further 1,000 feet. This incline is being equipped with a mechanically driven rope haulage. The accommodation at the main station is being enlarged and improved upon so that all loaded trucks will come in from the south to be dumped by power-driven tipplers, the empties passing out to the north. The main drive from No. 3 shaft, where no work is at present being carried on, will soon be connected up with the main incline from No. 2 shaft, and development work will then again be started at No. 3 shaft; the ground broken in the workings from that shaft will be delivered through this connection by mule haulage.

PRINCESS ESTATE AND G.M. CO., LTD.

Reorganisation Completed—Main Reef Development Values—The Financial Aspect.—Large Expenditures on Capital Account.

Reorganisation of the Princess Estate Company has been proceeding for some months past, and it will be some little time yet before the company is in a position to reap the full benefit of the amalgamation of the Roodepoort Central Deep and Princess Estate and G.M. Company, the absorption of the West Roodepoort Deep, Limited, and the Norman Properties Syndicate, Limited, and the enlargement of the company's plant.

Abnormal Conditions.

These unprofitable operations are easily understood when it is taken into consideration that the remodelling of the equipment and change over to the new plant, which was only completed in December, seriously interfered with operations. Absorption of gold in tube mills, plates, and furnaces, combined with a decline in grade, which there is every reason to think is only temporary, and a severe shortage of native labour, have all assisted in rendering returns abnormal.

History of the Company Summarised.

Before describing the new equipment and the work of reorganisation that has been carried out at the mine, it may be advisable briefly to cover the history of the company and to outline its present status as regards property and capital. The Princess Estate Company was originally registered in 1889, and reconstructed in 1890. The first dividend paid was in June, 1897—10 per cent. The company restarted a portion of its 50-stamp mill in 1904, increased the battery to 60 stamps in 1907, and in 1908 added a slimes plant. Payment of dividends was resumed in December, 1908, and up to date the company has distributed 72½ per cent. amongst shareholders. Last year the Princess absorbed the Roodepoort Central Deep, the former Saxon property, and the West Roodepoort Deep. The company now possesses the freehold of 3,337 acres of estate, and the enlarged venture has a mining area containing at the end of 1910 about 665 intact Main Reef bearing claims and about 521 intact claims carrying South Reef. The authorised capital is £650,000, the registered capital (all issued), £575,033, whilst at the end of 1911 the balance of debenture issue unredeemed amounted to £6,460, which was due for payment on July 1st, 1912.

A Broken Mine.

The Princess Estate has always been a difficult mine to operate. The property is broken by innumerable faults, and the rich South Reef, which has constituted the mainstay or backbone of the property, is exceedingly thin. Under these conditions mining costs have, of course, always ruled at a high figure. Fortunately for the company, the dislocations of the reef by faulting are remarkably uniform as regards the direction in which the reef is thrown. Were this not the case, and the management had continually to be groping and prospecting for sections of ore, the Princess could scarcely, we imagine, be worked at a profit. The Roodepoort Central Deep section is a much more settled proposition, but here, too, on account of the thin character of the South Reef and the small capacity of the plant, working costs have always prevailed at a high figure. Up to the end of 1910 the average working costs of the Roodepoort Central Deep Company had been 27s. 7d. per ton. As to the other areas absorbed—the West Roodepoort Deep and the Norman Properties—it may be remarked of the former that the ground has been much faulted, especially in the region of the western shaft, whilst in the Norman properties ground—the old Saxon mine—mining operations were carried on with difficulty, a large dyke and great quantities of water being encountered.

The Benefits of Amalgamation.

We do not here propose to deal at length with the several advantages claimed for the amalgamation of these mining areas, but in order properly to appreciate the present-day position of the Princess Estate, it will be necessary briefly to recapitulate the outstanding beneficial features of the fusion. Firstly, as regards the old Princess, the available tonnage of South Reef ore remaining in the mine was recognised to be decreasing rapidly. Hence, to counterbalance the unavoidable decrease to be expected in the profit per ton, it was deemed essential to enlarge the capacity of the plant. Such a step, however, would not be justified if the company relied only on the quantity of ore still remaining in the Princess property. Accordingly negotiations for the acquisition of further ground were commenced. The old Saxon company did a considerable amount of work in opening up the property, and a certain quantity of ore was crushed. The results then obtained were not profitable, but might be attributed to the fact that the conditions in those days were very different to what they are to-day. The Roodepoort Central Deep property lies immediately south of the Princess mining area, and the two mines are already connected by a winze. This company suffered considerably in the past in consequence of having only one shaft, which prevented it from handling a sufficient tonnage to enable it to earn such profits as would have made a return to its shareholders possible. The financial position of that company was such that the sinking of another shaft was precluded, while all profits earned would for some time to come have been swallowed up in paying off its debts, which consisted partly of debentures and partly of current liabilities. The property consists of 205.51 claims, and, although it had mined and milled a portion of its South Reef, there still remained very considerable reserves—partly opened up and partly untouched—to be exploited. In the past the company has done very little work on the Main Reef, but, in view of the success obtained by other companies in the district in developing this ore body, it recently directed its attention thereto, with satisfactory results.

The West Roodepoort Deep property adjoins the Roodepoort Central Deep on the west, and by extending the workings of the former company to the boundary the two mines can be quickly connected with each other. The West Roodepoort Deep owned 231.12 claims, situated south of the Main Reef outcrop, and as, owing to the unsatisfactory financial position of the undertaking, the producing stage was never reached, the original ore contents are still intact; they have, however, been proved to a small extent by means of two shafts and development drives. Speaking at the last annual meeting of the Princess Estate, Mr. M. Elkan, who presided, remarked: "If the amalgamation proposals are sanctioned, it is your Board's intention to concentrate the reduction operations at the site of the present Roodepoort Central Deep plant, and to make immediate provision for the treatment of 18,000 tons per month. Naturally, we do not intend to stop there, but we hope to be able in due course to considerably increase this tonnage. Before we can move in that direction, however, we must be absolutely sure that we have ample ore reserves, and no pains will be spared to push development ahead with all possible speed. The Roodepoort Central Deep workings have already attained a considerable depth—that company's main shaft has been sunk 3,604 feet—while the shafts of the West Roodepoort Deep were stopped at 1,609 feet and 1,690 feet respectively. It will therefore be much cheaper to push development work forward in the latter property. In doing so the two mines will be connected, one effect of which will be to considerably improve the ventilation in the Roodepoort Central Deep section, which at present is not all that could be desired."

Development and Ore Reserves.

It will now be necessary to consider the position with regard to development. In the following table is stated the footage

driven on reef during 1911, together with values and widths:—

Quarter ending—		Feet driven, &c., on Reef.	Aver. Value. Dwts.	Width Ins.
March...	South Reef	1,344	6.98	24
	Main Reef	1,690	6.35	26.5
June	South Reef	1,075	8.7	24
	Main Reef	915	5.37	46.45
September	South Reef	1,175	7.19	24
	Main Reef	755	5.77	40.43
December	South Reef	435	5.8	24
	Main Reef	665	4.2	41.2

At the end of 1910 the ore reserves stood at 665,000 tons of 7.8 dwts. value, which have been increased during 1911 by 35,871 tons, so that on the 1st January, 1912, they stood at 700,871 tons of 7.44 dwts. value. Large quantities of water have been pumped out in the Saxon and West Roodepoort Deep mines, and it is anticipated in the future substantial tonnages of ore will be added to the reserves from these western sections. For the time being, however, attention is being concentrated on the Princess and Roodepoort Central sections. An increasing proportion of Main Reef has been mined and milled of late years, but the South Reef is still the larger contributor to the battery, although, with a more centralised plant and a lower rate of expenditure, it is evident that the lower grade Main Reef sections will yield increasing profits. And on the subject of costs, it should here be made clear that, despite enlargement of equipment and the use of more efficient machinery than heretofore, this Roodepoort venture, on account of the peculiar conditions obtaining there, cannot be expected to operate at anything approaching the low figures recorded by the mines of the Central and East Rand possessed of big mills and large widths of reef. On the average, 30 per cent. of the ore mined has to be rejected as waste, and, as already stated, there is scarcely a 100ft. drive in the Princess Estate section which is free of faults. However, when the company is operating on a crushing basis of 18,000 tons or more per month, a substantial reduction in administrative and operating charges will result, with a consequent beneficial influence not only on profits, but also in giging to substantial tonnages of low grade ore a profitable value.

The Remodelled Surface Works.

On the old Princess surface works practically no work is being carried on at present. The mill is idle, but slimes are being treated there. Ore drawn through the Princess shaft is conveyed by locomotive to the Roodepoort Central mill. Here the new equipment is being concentrated. Machine shops have been centralised, and the Central mill, which now consists of 50 stamps and five tube mills, is being increased by a further ten stamps, which are being moved from the Princess section, and which should be ready for work in the course of a few weeks. The cyanide plant has been remodelled, and is of very efficient pattern, with Caldecott table and cones, Butters' distributors, etc. Three air compressors of from 75 to 80 drills capacity are installed. Until quite recently the Princess Estate Company had not employed machine drills for stoping, but latterly Ingersoll and Waugh hammer drills have been utilised, and the results secured have been encouraging. Of course, on the thin rich South Reef a policy of machine stoping has to be proceeded with very guardedly, despite an acute shortage of labour. The labour complement of the Princess is, as a matter of fact, placed at about 4,100, but at present only somewhat over 50 per cent. of this number are registered in the company's books, and until an adequate supply of labour is available the Princess company cannot reap the benefit of the reorganisation and renovation work recently carried out. However, the labour position is improving, and it is hoped that within the next few months the company will be earning substantial profits, and at the same time development will be actively prosecuted.

Having regard to the faulted nature of the reefs in the Princess section, and to the facts that the West Roodepoort Deep and Saxon areas are as yet unknown quantities, it would be extremely rash to venture any predictions as to the life of the new concern. However, one may with confidence assert that the proposition will have a period of productive existence which will run into a considerable number of years. It may perhaps at some future date be deemed in the best interests of the company to further extend the reduction and treatment plants at the Central mill, but before this is done one would like to see development pushed on with, and the value of the ground situated to the south-west of the original Princess mine more definitely established than is the case at present. That payable values are being secured over large stretches of Main Reef is a most gratifying feature.

THE MODDER DEEP LEVELS.

Significance of the Excellent Shaft Assays—Cheap and Easy Mining—What Results mean to Surrounding Properties—Economical and Rapid Shaft Sinking—Novel Arrangement of Shafts—Some Conclusions—Finances of the Company.

The outlook for the further East Rand is particularly rosy at present. Simultaneously with the announcement of the earning of a record profit at the Modder B. mine, and the notification of almost equally satisfactory earnings by the New Modderfontein, Brakpan Mines, and Van Ryn, came the recent announcement that the Main Reef series has been encountered in the No. 1 shaft of the Modderfontein Deep Levels Company at a depth of 2,990 feet. The dip to the south is in the neighbourhood of 11 degrees, and the assay results are excellent. According to the official statement, the reef series consists of hanging wall leader, value 24.88 dwts. over 27.9 inches, including partings, followed by 31 inches of waste. The middle reef assays 23.78 dwts. over 6 inches, and is separated by 22.6 inches of waste from the footwall leader, the latter being 39 inches wide, including partings, and assaying 7.26 dwts. per ton. The average of the whole body, including waste, is 126.5 inches wide, assaying 8.84 dwts. per ton. The deepening of the shaft and the cutting of the station are in hand, and will take about two months to complete. It was anticipated that the reef would be cut at a depth of about 2,750 feet, so that the ore body lies between two and three hundred feet deeper than was expected. The outstanding feature of the strike is the great width of the reef—10 feet 6½ inches. With sorting a recoverable value of approximately 10 dwts. per ton is indicated.

Work was started in 1910. Two shafts are being sunk close to one another, only about 100 feet apart. This is according to the style of operations conducted in some of the German coal-mining enterprises. Connection has been made between the two shafts at 700 feet and 1,400 feet, and will be made at the bottom. Great advantages will accrue for ventilation of the mine and safety exit for those employed underground.

Neighbouring Mines.

Reference to the map shows that the Modderfontein Deep Levels property lies on the dip of the New Modderfontein, adjoins Van Ryn Deep on the east, and has as its neighbour on the south the Government Gold Mining Areas. The eastern apex of the ground of the Modderfontein Deep Levels abuts on the claims of the Modder B. Company. It will thus be realised that the mine is in most excellent company. In fact, it is in the rather unusual position, for a mine which has only just cut the reef, of being surrounded by four mines, in all of which the reef has been opened up. The New Modderfontein and Modder B. are producing and earning large profits, the Van Ryn Deep is in an advanced stage of development, and in the Modderfontein Government Areas the reef has been cut in two shafts, and the others are nearing the ore body.

Moreover, the position of the Modder Deep between the New Modder and Brakpan, and the reef conditions obtaining in these properties justify the belief that the section disclosed by the shaft is not by any means an isolated one, and that similar values may reasonably be expected to prevail over a considerable portion of the company's ground.

Careful Assays.

The necessarily brief official statement may be supplemented by some further facts. It is known that the utmost care was devoted to the sectional assay of the reef in the shaft. No less than 73 assays were taken, and a striking feature is the great uniformity shown. There is a welcome absence of erratic or "freak" assays.

Easy Mining.

The mining width, estimated on the basis of the shaft assays, obviously lends itself to cheap and easy mining. Mining will be further facilitated by the fact that the mine extends along the strike rather than on the dip, and can, therefore, be easily developed, laterally, by means of its twin shafts.

Excellent Shaft Sinking.

Plainly, very rapid shaft sinking has been done. More than one record was broken in the course of the work, and the result is that the No. 1 shaft has been sunk 2,990 feet in twenty-one months—the first 60 feet, done by hand drilling, being excluded. Moreover, the actual cost of shaft sinking is well under the estimates. As the official statement explains, some time will elapse before the necessary work of station cutting can be completed, and doubtless it will be more than two months before further details of development are available.

The Financial Position.

The financial position is eminently satisfactory. The company has still in hand a sum of £125,000 with which to pursue work. The capital is small, thus facilitating the issue later on of the further amounts required to equip the mine. It will be remembered that options on 100,000 shares to Messrs. Goerz and Co. at 55s. ran off, unexercised, on June 30th last. The capital of the company, therefore, stands as follows:—Old capital, 100,000 shares; 1910 issue at 45s.; 150,000 shares; payment for Kitzinger block, 13,000 shares; total, 263,000 shares. Assuming a dip of 11 degrees and a milling width of, say, 99 inches, going 10 dwts., we get a possible total tonnage of 15,300,000 tons in the area of 377 claims with total gold contents of £32,488,500, after making allowances for dykes and disturbed ground. These calculations are necessarily more or less hypothetical, as they are based on the disclosures in the shaft alone and the assays and widths there discovered may or may not be maintained throughout the property. The foregoing estimates are, however, of much interest and not a little value, indicating as they do the great potentiality of this, the latest mine to enter the development stage on the Rand.

Some Technical Details.

It is interesting to recall that the plans prepared for the opening up of the mine possess at least one very interesting and novel feature. Instead of adopting what might seem the more obvious course of sinking one shaft and connecting up underground with the nearest shaft of the Modder State mines, it was decided to sink twin shafts, each of three compartments, at a distance of about one hundred feet part. This course is a novelty on the Rand, but is not unknown elsewhere, and there are in the present instance many obvious advantages attaching to it. Had but one shaft been sanctioned, and the future of the mine left to depend on the possibility of an early connection being made with a "State Mine" shaft, certainly a saving in capital expenditure of approximately £25,000 would have resulted. Against the saving, however, would have to be set the fact that the mine would have been dependent on the favour and goodwill of its neighbour, that development would have been restricted in comparison with what is possible with the two shafts, and that when it came to arrange the ventilation scheme with its neighbour, the single shaft might have to act as the upcast shaft for the whole of its own and many of its neighbour's workings. The system of twin shafts adopted, on the other hand, will permit of rapid development of both sides of the property; will facilitate and make for an excellent ventilation system, and will ensure the non-stoppage of surface operations in the event of breakdown in one shaft. The twin system of shafts adopted has several other special advantages. As the shafts are but 100 feet apart, it has been possible to concentrate the haulage engines and boiler plant between them, and to save much of the expenditure demanded by shafts separated by a greater distance.

Conclusion.

Making all allowances for the extent of reef tested, it is no exaggeration to state that the Modder Deep shows promise of a big future for itself and the whole East Rand.

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Authorised Capital £550,000
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Issued (fully paid up) ... ... 550,000 Shares.

DIRECTORS.

W. H. Dawe (*Chairman*)	*alternate*	W. H. B. Frank.
C. S. Goldman	,,	R. Goldmann.
Julius Friedlander	,,	G. C. Fitzpatrick.
W. T. Graham	,,	C. J. Meintjes.
A. Mackie Niven	,,	Robert Niven.
A. G. Gill.		
E. A. Wallers	,,	F. Boerckel.

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Wm. Wells.

CONSULTING ENGINEER.
S. C. Thomson.

MANAGER.
E. E. Hardach.

SECRETARY.
H. G. L. Panchaud.

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A. H. Downes.

HEAD OFFICE.
Cullinan Building, Johannesburg.

LONDON OFFICE.
Salisbury House, London Wall, E.C.

PARIS CORRESPONDENTS.
Compagnie Francaise de Banque et de Mines,
20, Rue Taitbout.

WITBANK COLLIERY, LIMITED.

Capital, 210,000 shares of £1 each (all issued) £210,000

DIRECTORS.

W. H. Dawe (*Chairman*)	*alternate*	W. H. B. Frank.
H. A. Rogers		
Julius Jeppe	,,	A. Barker.
C. S. Goldman	,,	R. Goldmann.
J. H. Ryan	,,	Bailey Southwell.
A. G. Gill	,,	W. H. B. Frank.
H. J. King	,,	Paul Dreyfus.
E. A. Wallers	,,	C. J. Meintjes.

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MANAGER.
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BUSINESS MANAGER.
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SECRETARY.
H. G. L. Panchaud.

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HEAD OFFICE.
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LONDON OFFICE.
Salisbury House, London Wall, E.C.

THE RIETKUIL GOLD MINES, LIMITED.

Capital, in Shares of £1 sterling each £120,000
Issued Capital (fully paid) £90,000

DIRECTORS.

W. H. Dawe (*Chairman*)	*alternate*	W. H. B. Frank.
C. S. Goldman	,,	R. Goldmann.
J. H. Ryan	,,	J. G. Currey.
A. G. Gill.		
F. R. Lynch	,,	A. S. Pearse.

LONDON COMMITTEE.
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H. G. L. Panchaud.

LONDON SECRETARIES.
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LONDON OFFICE.
Salisbury House, London Wall, E.C.

TREASURY GOLD MINES, LIMITED.

Capital, 135,000 shares of £4 each (fully paid), all issued.

DIRECTORS.
W. H. Dawe (*Chairman*).

J. Friedlander	*alternate*	H. W. Anderson.
A. G. Gill.		
J. Andrew Cohen	,,	Lionel Cohen.
C. S. Goldman	,,	R. Goldmann.
E. J. Renaud	,,	J. Jourdan.
W. H. B. Frank	,,	J. Morisse.

LONDON COMMITTEE.
J. L. Bergson. C. Pakeman.

CONSULTING ENGINEER.
S. C. Thomson.

SECRETARY.
H. G. L. Panchaud.

LONDON SECRETARIES.
A. H. Downes.

HEAD OFFICE.
Cullinan Building, Johannesburg.

LONDON OFFICE.
Salisbury House, London Wall, E.C.

PARIS CORRESPONDENTS.
Compagnie Francaise de Banque et de Mines.

MAIN REEF WEST, LIMITED.

Capital £491,188
In 491,188 Shares of £1 each.

BOARD OF DIRECTORS.

W. H. Dawe (*Chairman*)	*alternate*	W. H. B. Frank.
C. S. Goldman	,,	R. Goldmann.
E. A. Wallers	,,	F. Boerckel.
J. Munro	,,	P. Richardson.
J. Crewei	,,	D. Symons.
E. Wolfes	,,	A. G. Gill
H. J. King	,,	Paul Dreyfus.
C. H. Mullins, V.C.	,,	C. J. Meintjes.

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J. L. Bergson.

CONSULTING ENGINEER.
S. C. Thomson.

GENERAL MANAGER.
C. H. Spencer.

SECRETARY.
H. G. L. Panchaud

LONDON SECRETARIES
A. H. Downes.

HEAD OFFICE.
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Salisbury House, London Wall, E.C.

PARIS CORRESPONDENTS.
L'Association Miniere.

LEADING MINES OF NEUMANN GROUP.

THE MAIN REEF GROUP.

PROSPECTS OF THE CONSOLIDATED MAIN REEF AND MAIN REEF WEST DISCUSSED—DEVELOPMENT POSITIONS IN THE TWO PROPERTIES—NEW SHAFTS AND THEIR SIGNIFICANCE—PROSPECTS OF MILL EXTENSION.

1.—CONSOLIDATED MAIN REEF MINES AND ESTATES, LTD.

During recent years the Consolidated Main Reef Company has derived a large portion of its profitable ore from the western section, although the more central portion has also yielded a fair tonnage of payable rock. The eastern area of the property has, however, proved most disappointing, and although to-day an improvement is to be observed on the nineteenth level going towards the Consolidated Langlaagte western boundary, too much importance is not at present attached to this development as in the eastern areas time after time short stretches of good ore have been exposed which on further development have proved to be of very limited extent.

THE CENTRAL AREA.

The position in the more central (or rather west central) of the company's claims is, however, most encouraging, and there is seemingly everything to justify the view that the development work carried out there during the past few months puts an improved complexion on the affairs of the company. Development in the Consolidated Main Reef may be said to have improved consistently for twelve months past. The Main Reef Leader values in the western section (that is to say, as the Main Reef West's eastern boundary is approached) are much better, the existence of a stretch of about 3,200 feet of good ore extending from the western boundary in an easterly direction has been established, ore values and widths appear to be increasing somewhat in depth, and as already stated there are signs of an improvement in the eastern area, although no real measure of importance is as yet attached to this latter improvement. The good values in the adjacent Consolidated Langlaagte Mines extend up to within 400 feet of the Consolidated Main Reef's east boundary, but there is then, it seems, a poor section intervening between the western side of this good zone and the central section of the Consolidated Main Reef. Good values, too, are being obtained on the Consolidated Main Reef's 20th level, the east drive showing

most encouraging results for a distance of over 1,000 feet. In connection with the Consolidated Main Reef Mine reference must be made to a transverse dyke which outcrops near the battery and strikes through the western section of the property. This stratigraphical disturbance appears to affect ore values unfavourably; at any rate the assay plan shows impoverishment in its immediate vicinity. Taken on the whole, however, the Consolidated Main Reef appears to be in a better condition to-day than has been the case for some time past.

The New Deep Level Shaft.

A point of attack of the very greatest importance to the company is the new deep level vertical shaft which is of seven compartments, and is expected to intersect the reef at a depth of about 2,500 feet. This shaft will explit the deeper areas of the property at a depth corresponding to that which will be opened up by the two shafts of the Main Reef West. Great importanee attaches to the reef disclosures from this shaft. It is designed to exploit a very large deep level area, and through it a big tonnage will be hauled. Should developments from this shaft prove satisfactory, the question of increasing the plant will doubtless be considered.

The Joint Mill and Cyanide Works.

The joint reduction and treatment plants of the Consolidated Main Reef and Main Reef West are situated a little to the east of the west incline shaft of the Consolidated Main Reef Company. There are here 240 stamps, 6 tube mills, and the necessary cyanide treatment equipment. Each company possesses 120 stamps and 3 tube mills, the monthly crushing capacity of each company being about 25,000 tons, or 600,000 tons per annum for the joint equipment.

As to Labour.

In this connection attention may be directed to the labour shortage at the two mines, and it may be remarked that with a view to improving matters in this direction, the management have obtained valuable assistance from the use of small rock drills. The Consolidated Main Reef, on aecount of its being an old-established outcrop venture, has always been a favourite with natives. This company's complement is about 3,100. On the western side of the battery there is room for erection of a further 80 stamps, 40 on each side of the mill, and provided developments in the two mines warrant it, such augmentation of reduction equipment will doubtless be carried out in the not far distant future.

Finances, Life and General Prospects.

Before concluding this review of the Consolidated Main Reef some examination of the financial circumstances of the company, of the outlook regarding life and the general prospects of the concern as indicated by the present conditions is called for. Firstly, attention may be directed to the fact that the balance-sheet for the year ending June 30, 1911, showed that the company had cash on hand on fixed deposit with bankers in London, etc., amounting to £236,397, whilst £36,459 remained on dividends unpaid, etc. Evidently the Company is in a position to take advantage of any important improvement in the underground position by the erection of further reduction and treatment plant, thus increasing the revenue and profits of the mine, and by reducing the cost of working bringing a substantial low grade tonnage within the realm of profitable value. As to life, this Company, with its absorbed areas of the now defunct Main Reef Deep and Main Reef East Companies, seems on its present basis of exhaustion to have before it a period of productivity amounting to approximately fifty years, and this might well be increased were better development results secured in the eastern end of the property. Of course an augmentation of reduction plant would increase the rate of exhaustion, but in any case the Company has clearly a large amount of ore to be developed and milled, and in view of recent developments one is justified in looking forward to the earning of somewhat larger profits in the near future than of late have been announced.

II.—Main Reef West, Ltd.

The principal point of interest at the Main Reef West to-day is the far western shaft, which struck reef at the seventh level. The very serviceable and compact installation, with large ore bins, rock breakers, and sorting plant, at this shaft, has recently been completed. This shaft is to be sunk to a vertical depth of 3,000 feet, or possibly more, the idea being to facilitate rapid hoisting and obviate the haulage difficulties incidental to a compound shaft. Cross-cuts will be carried to the reef and main loading bins installed at main levels.

Recent Developments.

The exploitation to date points to the existence of a block of good ground extending for 3,300 feet or more from west to east. Towards the Bantjes Consolidated Mines values fall off, and the most profitable section in the property lies in a compact block adjacent to the Consolidated Main Reef boundary. Another point to be borne in mind in regard to the Main Reef West is that the South Reef in the Aurora West is of good value, and although this body has not so far been of mueh value to the Main Reef West, it may prove an important asset in the future. The completion of the work at the new Western shaft marks the commencement of a new era in the history of the Main Reef West. Of course, a sufficiency of native labour is required in order to reap the full benefit from the work carried out in the western portion, but in order to supply the battery with an increased amount of ore from the two shafts of the Main Reef West, the railway gauge has been increased from 2 ft. to 3 ft. 6in., and large ore trucks of 40 tons capacity, similar to those in use at Randfontein, have been purchased.

Labour at the Main Reef West.

The Main Reef West Company is not nearly so favourably situated with regard to native labour as the "Consolidated." Signs of improvement in regard to labour are, however, not at present wanting. With only one shaft at work, the largest tonnage this company had sent to the mill in one month was 18,000 tons, but now that the new western shaft is practically in commission, the company will (provided more native labour is available) be able largely to increase this tonnage.

General Prospects.

The property of the Main Reef West, Limited, consists of 564 claims, with an actual area of 549.6 mining claims. The area is a large one, and without indulging in any hard and fast estimates (such calculations are seldom substantiated by actual results in regard to Witwatersrand mining), it is patent that the life of this concern on its present stamping basis is rather above than below the average for Rand concerns. At the same time, it must be borne in mind that an increase in stamping equipment may well be sanctioned should further development results justify such a policy, and from the manner in which the mine has opened up to date—only about 8 per cent. of the ore so far exploited has proved unprofitable—there is every reason for believing that such a course will be warranted.

The outlook for the company may be described as encouraging. Exploitation of the western section from the new vertical shaft will open up new ground, for which there is every reason to entertain favourable anticipations. No doubt steps will be taken to enlarge the scope and productive basis of the company at some future date, and with an improvement in the labour supply the company could apparently earn substantially larger profits almost immediately.

THE KNIGHT CENTRAL POSITION.

The Necessity for Ample Ore Reserves—A Two Years' Margin Last December—Much Improved Development Results Latterly.

Mr. S. C. Thomson, the consulting engineer to Knight Central, had a difficult task before him when he endeavoured recently to look at matters from a sanguine point of view. "Although the tonnage milled during the past year was 13,000 tons more than the previous year, this increase is not reflected in increased profit, even with the slight improvement in the yield per ton from 22s. 9.4d. to 23s. 3d." After quoting the ever-present labour difficulty as an explanation of this, he added: "As far as the mine itself is concerned, the development has suffered through similar conditions; but at the same time I cannot see that there has been any falling-off in the percentage of payable ore or in the average value of the payable percentage. The area of your holding is a large one, and, given sufficient labour at reasonable cost, I see no reason why the position should not improve, even assuming that there would be no alteration for the better in the average grade of the ore." With the aid of these stimulative and encouraging remarks, the average hopeful shareholder would doubtless have been able to reassure himself were it not that the manager mentioned a little further on that "approximately 39,700 tons, which were included as payable in the ore reserves at the end of 1910, have been excluded from the estimates, because the additional information now available indicates too low a value to warrant inclusion."

Reserves at 31st December, 1911.

The payable ore developed was classed as follows:—

Tons.	Dwts. Value.	Stoping Inches. Width.
83,630	4.17	57.88
136,500	4.78	57.36
101,870	5.48	61.51
205,500	6.65	64.14
56,770	7.51	70.94
60,030	9.04	52.01
Total and averages... 644,300	6.04	60.56

As working costs for the year averaged 18s. 9d., or say 4.5 dwts., it is obvious that about a third of the ore reserves above shown are only on the margin of payability. The total quantity estimated is a decrease of 56,700 tons on the reserves of the previous year, part of the decrease being due to the exclusion of the 39,700 tons already referred to. With regard to this aspect of the company's affairs, Mr. W. H. Dawe, the chairman, addressing the shareholders at the annual meeting recently said: "It is undoubtedly disappointing that the large amount of work done did not result in a considerable increase in the ore reserves; and it was that consideration which led your directors to the conclusion that it was in the best interests of your company that no dividend should be declared in December last. At the last annual meeting I dealt with this question very fully, and gave the reasons why a dividend of 5 per cent. was declared in 1910, explaining that the declaration of a dividend in 1911 would depend entirely on the results of development. These results, as you are aware, were disappointing, and I adopted the best course possible in deciding to strengthen the cash resources of the company." Ample development then and good values are the primary requirements of the Knight Central. The quantity of ore milled last year was 315,171 tons, so that the payable ore reserves listed at the 31st December last amounted to just about a two years' supply. For the first three months of this year, moreover, profits showed a very considerable decrease.

Improved Development Values.

The grade has latterly improved, however, and developments have shown so much better results that the chairman has had reason to be thankful for the various circumstanees that have led to the postponement of the annual meeting, for, as he remarked, "the latest information is of a distinctly more hopeful character than that which we have had for some time previously." Briefly recent operations have shown these results:—

West Shaft.

	Distance Feet.	Value. Dwt.	Stoping Width. Inches.
M.R. 1st level west	235	15.5	51
of which last	25	12.5	73
S.R. results varying from	—	11 to 16	average
S.R. Leader 9th level east	130	11.4	36
S.R. 11th level west	60	12.8	68
S.R. 12th level west	515	5.5	65

The last figures include 75 feet of unpayable reef, and are, therefore, sufficiently satisfactory. The results quoted refer to the western section of the mine. In the eastern section the 13th and 14th levels were very poor, but the 15th level, which is the lowest in the eastern part of the property, is giving encouraging values—the last 40 feet driven east and west averaging about 7 dwts., while the total of 310 feet driven in both directions gives an average of 8.5 dwts. over 50 inches. In commenting on these figures, Mr. Dawe said: "It would not be wise to assume from these values that the outlook has entirely changed, but one must admit that they are distinctly hopeful indications, especially as they occur at different points of the mine. A continuance of these values would mean that the ore reserves would be rapidly increased," and in conclusion he added: "I sincerely hope that the information which I have given you is the beginning of a more prosperous time." The hope will be shared by many others, and more confidently than for some time past.

THE WITBANK COLLIERY.

A Sound Position—The Value of the Uitspan Mine—Ability to Produce 100,000 Tons per Month—A Life of at Least 30 Years Anticipated.

The Witbank Colliery has well earned the distinction of being South Africa's leading coal producer. Situated in the heart of the Middelburg-Witbank coal area and alongside the main Pretoria-Delagoa Bay railway, the Witbank Colliery's loading bin for the South African Railways is 91 miles from Johannesburg by way of the railway through Brakpan and it is distant 276 miles from Delagoa Bay, the port and gateway of the Transvaal. The Witbank pits are, it will thus be seen, favourably situated with regard to the great gold mining industry of the Witwatersrand and at the same time to the coast.

Possibilities of an Export Trade.

Mention of the coast and Delagoa Bay naturally opens up the question of an export trade. The possibilities of such a trade have on more than one occasion been carefully enquired into by those who direct the destinies of coal mining in this country. India, for instance, has been looked upon as a likely customer, and many other parts of the industrial globe have come within the scope of the South African collieries' commercial designs. That there are vast areas of coal in the Transvaal, and that such areas are favourably situated with regard to the sea board cannot be denied. At the same time one is forced to the conclusion that with the present coastwards rates on coal and under the existing conditions of loading, etc., at Delagoa Bay the prospects of creating a really important export trade are very small. The one shilling per ton rebate granted by the S.A.R. from the 1st of August, 1912, is, after all, quite inadequate for the needs of a substantial export trade. No doubt the day will come when under different conditions the coal pits of the Transvaal will derive a full share of benefit from the exportation of coal to other countries. For the present the Transvaal collieries must, it seems, look to the internal trade of South Africa for the sale of coal, but at the same time the possibility of an export trade must not be ignored, for such a trade will one day afford a really broad market for Transvaal produce. To-day sales have to be carefully regulated by a parental Coal Owners' Association, and from this fact and from the statistics published as to output and selling value, it is patent that the market is cramped and narrow. It is notorious that Transvaal coal is the cheapest in the world, and when one takes into account its average calorific value, especially in the Witbank area, one cannot but feel that in the fulness of time the more important of the Transvaal collieries will secure the larger share of prosperity which by all right of industry is theirs.

The Witbank Colliery Company's property consists of the following:—Witbank, 2,428 Joubertsrust, 1,057; Uitspan, 225; freehold portion of Blesboklaagte mineral rights, 4,216 morgen (approximately 8,920 English acres). On these areas two collieries have been opened up—the original Witbank mine and the Uitspan Colliery, situated slightly over three miles to the east; that is to say, towards Delagoa Bay. It will here be best to consider these two propositions separately.

The Witbank Pit.

The Witbank main shaft is situated within a stone's throw of Witbank Station. The main shaft strikes the coal seam at a vertical depth of 110 feet and is situated but a few yards from the old circular shaft which has now fallen into disuse. The shafts, hoisting, electric, and picking and screening plants, together with the offices of the company, are, as already stated, in close proximity to the South African Railway line, and the whole plant and offices, etc., form a compact and well-laid-out establishment. The main Witbank shaft contains two compartments, and in each of these a double-decked cage is operated. The tonnage delivered to the picking belts from this shaft is greatly augmented by the delivery of coal by mechanical haulage from the south side of the mine, from which section the greater part of the Witbank tonnage is now being won. The south incline shaft is situated some 4,000 feet from the main vertical pit. About 2,600 trucks per day are pulled by mechanical haulage from this south incline, and the haulage could, if necessary, deal with 4,000 trucks or, say, 2,000 tons of saleable coal per diem.

Ability to Produce 100,000 Tons per Month.

The Witbank Company's output has, however, to be regulated and determined by agreements existing between the members of the Coal Owners' Association, by the extent of the demands for coal received by the Association and by the nature of contracts obtained. At the present time the Witbank Company is producing from its two collieries at the rate of between 60,000 and 70,000 tons per month, inclusive of "duff," or fine coal. The largest monthly output made by the concern has been about 75,000 tons, and there can be no doubt that a production of 100,000 tons per month would not be beyond the productive ability of the company were such an output called for. The coal seam in the Witbank mine has an average thickness of about six feet. There are about 200 working faces in the property. All the haulages at the Witbank mine are now electrically worked, and in order to ensure their efficient operation a 750 b.h.p. motor has recently been installed. Air shafts have been sunk at frequent intervals, and the ventilation conditions are stated to be wholly satisfactory. Moreover, both the mines and the company, in common with the great majority of South African collieries, are free from gas.

The Uitspan Mine.

The Uitspan Colliery, which has now been in operation for about seventeen months, is situated about 6,000 yards south-east of the Witbank shaft. The plant erected here is of simple yet efficient type, and is of course capable of expansion should a larger output be called for from the Uitspan section. No electric plant has been installed, and there is thus no electric light underground. Neither are there any coal cutters at work. Steam boilers of the Robey portable type are erected, and a well-laid-out screening plant is in continual operation. A siding has been completed and a locomotive is in operation for despatch of the Uitspan produce to the main line. The expenditure on the Uitspan equipment figures in the last balance sheet of the company, viz., that for the year ended August 31st, 1911, at £23,395, and the company must be congratulated on having expended such a comparatively small sum in the development of an exceptionally valuable asset.

A Valuable Property.

The coal at the Uitspan Mine is of excellent character, and the seam is approximately 14 feet in thickness. The incline shaft, which "falls" about one in six, cuts the seam at 50 feet, and a main road has been driven for 1,200 feet in a westerly direction. It may here be remarked that about 10 per cent. of the company's produce is waste or stone, and 8 per cent. duff, for which latter a market is now found.

A Fine Record.

The Witbank Colliery Company has up to date produced between five and six million tons of coal, and has returned to shareholders 200 per cent. in dividends. The company carried forward a balance of £40,495 at the end of August, 1911, is possessed of mineral rights over nearly 9,000 acres of ground on the main Pretoria-Delagoa Bay line, and has two well-developed and equipped collieries capable of producing about a million and a quarter tons of marketable coal per annum. Moreover, the great bulk of the company's property is coal-bearing. It is indeed estimated that the company can rely on a production of approximately 22,000,000 tons of saleable coal, which at an output of 60,000 tons per month gives the colliery a life of over 30 years. As a matter of fact, it is likely that this estimate will be substantially exceeded in actual practice. Having regard to all these facts, it should be abundantly clear that the Witbank Colliery Company is in an exceptionally strong position. The company has joined the Association—an institution which had as its avowed object the maintenance of a fair price for Transvaal coal—and it may be safely presumed that the Witbank Colliery is an important factor in that corporation. For instance, although the output for 1911 was more than 100,000 tons below that for 1910, the company maintained its rate of dividend at 30 per cent., and in face of the continued decline in selling price of Transvaal coal at pit's mouth (despite the efforts of the Coal Owners' Association) the dividends distributed last year were 5 per cent. in advance of the 1909 distribution, although the output for that year was announced at 740,497 tons as compared with a production of 713,480 tons in 1911. During the current year profits have been well maintained, and the company is in a strong financial position.

A Strong Position.

These are facts and figures which should not only prove a source of satisfaction to shareholders in the Witbank Company, but they should also prove of substantial importance to those interested in the coal trade of South Africa who are not shareholders. Taking everything into consideration, the outlook for the Witbank Company must be deemed satisfactory, despite the low price prevailing for fuel in this country. The mine is economically operated and, although we do not know what rate of working costs prevails at Witbank to-day we imagine that even further suicidal competition and a consequent further reduction in price could not appreciably affect the financial status and general prosperity of the Witbank Company, except for a very restricted period of time.



East Rand Proprietary Mines,

LIMITED

EAST RAND PROPRIETARY MINES, LIMITED.

Registered Capital	£2,514,000
Issued Capital	£2,445,897

DIRECTORS.

Sir George Farrar, Bart., D.S.O. (*Chairman*).
E. A. Wallers (*Vice-Chairman*).
Julius Friedlander (*alternate* G. C. Fitzpatrick.)
Gustav Imroth.
J. L. Jourdan.
F. Raleigh.
E. J. Renaud.
H. Ross Skinner.
E. Wolfes.

SUPERINTENDING ENGINEER.
H. Ross Skinner.

SECRETARY.
J. D. H. Lang.

ASSISTANT SECRETARY.
M. Kneen.

TRANSFER SECRETARY.
P. Lange.

HEAD OFFICE.
Farrar Buildings, Simmonds Street, Johannesburg. Box No. 742, Johannesburg. Head Office 'Phone 3582. Tel. Address "Flexor."

BUYER.
C. A. C. Tremeer, Farrar Buildings, Simmonds Street, Johannesburg. Box No. 839, Johannesburg.

MINE OFFICES.
East Rand, Box No. 57, East Rand; Tel. Address, "Cupel," East Rand. Mine 'Phone, 3712, Johannesburg, and 37, Boksburg. Nearest Railway Station, East Rand.

GENERAL MANAGER.
W. T. Anderson.

BUSINESS MANAGER.
H. P. Fraser.

CHIEF ACCOUNTANT.
C. G. Johnstone.

CHIEF MECHANICAL ENGINEER.
J. W. Forster.

CHIEF ELECTRICAL ENGINEER.
L. H. Wilms.

METALLURGIST.
E. H. Johnson.

EUROPEAN COMMITTEE.
S. H. Farrar. Sir S. Neumann, Bart.
J. B. Jacquot. F. Eckstein.

LONDON SECRETARY.
H. T. Hayward.

LONDON OFFICE.
4, London Wall Buildings, E.C.

PARIS CORRESPONDENTS.
Compagnie Francaise de Banque et de Mines, 20, Rue Taitbout.

The company comprises the following sections: Driefontein, Angelo, New Comet, Cason, Angelo Deep, Hercules. Of these the first four have their own complete reduction plants, the stamping capacity being allocated thus: Driefontein, 220; Angelo, 220; New Comet, 160; Cason, 220. Distributed over these plants are 25 tube mills, five at Driefontein, eight at the Angelo, four at the New Comet, and eight at the Cason. The underground management of the above sections is in the hands of Messrs. H. E. Barrett, L. P. de Castle, P. G. Theil, H. N. Fuller, and R. R. Perkin respectively. The mine employees on the surface and underground number no less than 1,800 white labourers, while there is a force of between 14,500 and 15,000 natives.

The mine covers a claim area of 4,331 claims, 932 claims of which are situated north of the Reef, and 3,399 south of the Reef. Of the latter, at the 31st of December last, 312 claims, equal to 9.2 per cent. had been worked out. The undermining rights of the Government areas, viz., townships, locations, water-rights, etc., within the property or in the immediate vicinity have been applied for,, and when granted will mean an addition to the total area of approximately 185 claims. The expenditure on machinery and plant and underground equipment for the first half of this year is made up as follows:—

Reduction Plant	£11,856
Pumping and Air Plants	4,623
New Surface Haulage, Driefontein to Angelo and New Crusher Station, Driefontein	19,297
Native Compounds	9,708
Shaft Sinking, Excavations, etc.	39,136
Sundry Surface and Underground Equipment	14,764
Total	£99,384

The approximate cash position at the 30th June may be summarised thus:—

Approximate financial position after providing for all liabilities, including dividend of 12½ per cent. but exclusive of the debenture issue of £1,500,000	£193,967
Less cash assets (stores, materials, sundry debtors, etc.)	146,756
Balance—approximate cash position	47,211

A fixed amount of 3s. per ton milled has been debited to working costs to cover development redemption, but during the six months under review the monies so accruing have not been fully utilised, with the result that at the 30th June last there was an amount of £70,549 standing at the credit of Development Suspense Account, which has been treated as a liability in the foregoing summary of the cash position. The development and sinking results throughout the property, for the six months, are as follows:—

	Feet.
Incline Shaft Sinking	430
Vertical Shaft Sinking	135
Sundry Shaft Sinking	289
Total	854

Development:—

No. of feet driven, risen, and sunk, excluding shafts ...	25,797
Average Reef Channel Width	24
Average Assay Value over Reef Channel Width ...	12.2 dwt.

The Angelo-Deep section has now been de-watered to the 27th level, permitting of driving and development operations generally being resumed in that portion of the mine.

The eight compartment vertical shaft at the Hercules section has reached a total depth of 3,272 feet, and when the reef has been tapped by this means an important step will have been gained towards opening up a large area of new ground for development and attack. Adequate pumping plant is in process of installation to cope with any inrush of water that may be expected on the western portion of the property. Attention is still being devoted by the management to the ventilation and the further improvement of the general underground conditions throughout the entire mine.

The new double-storied brick houses erected for the company's married employees are now all occupied, and the housing accommodation provided by the company for its white staff and servants has been brought to a very advanced and comprehensive stage. Mine Club buildings, each containing its billiard and reading rooms, etc., are provided for the various sections of the property, and there is erected near the main offices a large hall with all up-to-date appointments. A park covering about a

couple of square miles has been laid out with trees, and within which is a first-rate 18-hole golf course. Football, cricket and tennis devotees are also well catered for. In this way the leisure pursuits of the employees are rendered as accessible as possible. A dividend (No. 14), of 12½ per cent., appropriating an amount of £305,737, was declared in June last, for the first half of the current year.

THE PRESENT POSITION OF THE E.R.P.M.

A Continuance of Fair Returns—The Cleaner Mining Policy Applied—Satisfactory Development Figures—The Question of the Next Dividend.

The position of the East Rand Proprietary Mines, as indicated by the two quarterly reports which have appeared since the beginning of the year, cannot be regarded as other than satisfactory. Put as concisely as possible in figures, the salient points of the output over this period are as follows:—

1912	Stamps.	Tons Milled.	Revenue per ton Milled.	Costs per ton Milled.	Working Profit Total.	Profit per ton Milled.
March quarter	820	471,750	32/1	21/8	£244,740	10/5
June quarter	820	473,250	33/6	21/5	285,876	12/1

By way of comparison, the accompanying brief statement relative to the performances of the two previous years may be added:—

1910	820	2,126,334	27/3	15/6	£1,249,356	11/9
1911	820	2,194,552	25/0	16/8	913,561	8/4

The total working profit for the half-year ended June 30th was £530,616. The figures which will naturally attract most attention are those of recovery and costs, the former showing a notable increase on the averages of the earlier years, and the latter being little less expansive. The result, however, has been a marked improvement in the profits. An examination of the tonnage milled makes it evident that the rate of crushing has been reduced for, if the quantity put through during the past half-year is not exceeded during the remainder of 1912, the total crushing by the end of the year will be in the neighbourhood of 1,900,000 tons. It is clear that the policy of cleaner mining has been adopted as far as possible, as has already been explained in the *S.A. Mining Journal*, and foreshadowed in Mr. H. Ross Skinner's report. Closer sorting has also prevailed, as is apparent in the monthly returns, although comparisons can scarcely be made to advantage in this connection, for the effect of approximately equal percentages of sorting depends very much upon the original condition of the ore dealt with. A sorting of, say, 9 per cent. on the class of material that was being sent to the E.R.P.M. mills at certain periods last year would be of considerably less importance than a sorting of 9 per cent. on the average grade of ore that is now being provided.

The following figures, taken from the monthly analyses of the Chamber of Mines, give a general view of the progress of the E.R.P.M. since the beginning of 1912. They show, apparently, rather a different tendency to that which appears in the aggregate sums quoted in the preceding table:—

	Tons.	Revenue. £ s. d.		Expenses. £ s. d.		Profit. £ s. d.	
January ...	164,550	243,565	28/3	173,231	21/1	67,108	8/2
February ...	144,200	246,465	33/0	163,647	22/8	75,609	10/6
March	163,000	280,975	33/7	174,819	21/5	101,362	12/5
April	157,500	267,743	32/11	165,918	21/1	98,596	12/6
May	162,900	275,295	32/11	176,549	21/8	95,024	11/8
June	152,850	249,881	31/9	157,642	20/7	92,256	12/1

The tonnage milled in July is considerably less than it was in March, when the programme of betterment was taken in hand, and, in the same way, the recovery, which reached the high water mark of 33s. 7d. per ton in the same month, has been on the down grade. Expenditure, on the other hand, has been diminished, and profits continue to exceed £90,000 per month. It is possible, of course, to take a wrong view of these returns, unless one remembers that there is now no reserve gold to fall back upon for the purpose of adjusting the output declaration. The changes which were rendered necessary as a consequence of the methods previously pursued were of a somewhat revolutionary kind, the development was falling back, and already presented serious difficulties, and the problem was not so much to straighten things out again as it was to place them upon an entirely new footing. For this reason it would be unfair and unjustifiable to argue that an actual tendency, such as is indicated above, has set in definitely, and that the December output, for example, is likely to be as far below that of June as that of June is inferior, for example, to that of March. As was stated by Mr. H. Ross Skinner in his report upon the condition of the property: "The payable ore developed, during 1911, shows a shortage of 841,000 tons when compared with the actual ore mined. This shortage is accounted for by the curtailment of development operations, for financial reasons, in the latter half of the year, and by the difficulty of securing sufficient development faces for the required amount of work. . . . Concentration of work on the sinking of the secondary inclines and development shafts is, therefore, imperative in order to obtain additional levels as rapidly as possible." The statements regarding development operations for the half-year is as follows:—

	Total Footage (excluding Shafts).	Distance Sampled Feet.	Average Reef Width. Ins.	Av. Assay Value on Reef Dwts
March quarter	11,527	8,424	21.4	13.6
June quarter	14,270	10,367	26.0	11.2

For 1911 the figures under the same headings were:—

1911	59,820	37,843	26.1	10.0

Although it has not yet been possible to accelerate the speed of development to any great extent, it is satisfactory to note that the reef widths exposed and the assay results obtained, especially the latter, are distinctly satisfactory.

RAND MINING IN PICTURE—THE BARNATO GROUP



Consolidated Langlaagte



AFRICAN FARMS, LIMITED.
(Registered in Transvaal.)

Capital £650,000
Issued £649,631

DIRECTORS.
Julius Jeppe, *Chairman*.
Sir Abe Bailey, K.C.M.G. J. H. Ryan.
J. Emrys Evans, C.M.G.
A. G. Gill. Bailey Southwell.

SECRETARY: O. F. Brotherton,
for Witwatersrand Township, Estate and Finance Corporation, Limited (P.O. Box No. 5036), Jeppe Arcade, Johannesburg.

LONDON COMMITTEE.
G. H. Gasson.
G. Seymour Fort. Hugo Goldie.

LONDON TRANSFER SECRETARY AND OFFICE.
E. J. Sloan,
277 and 377, Salisbury House, London Wall, E.C.

CASSEL COAL COMPANY, LIMITED.
(Registered in Transvaal.)

Capital £250,000
Issued £200,000

DIRECTORS.
J. Dale Lace. L. Edwards. J. Jeppe.
J. H. Ryan. W. Ross.

SECRETARY.
J. E. Robertson.

LONDON COMMITTEE.
E. W. Tompson. J. E. H. Lomas. G. E. Lomas.

LONDON TRANSFER SECRETARY.
E. J. Sloan,
277 and 377, Salisbury House, London Wall, E.C.
Dividend, No. 7, 5 per cent., paid 1911.

DIEPKLOOF MYNPACHT CLAIM AND ESTATE COMPANY, LIMITED.
(Registered in Transvaal.)

Capital (in shares of £1 each) £250,000

DIRECTORS.
Julius Jeppe, *Chairman*.
A. G. Gill. Sir Geo. Albu, Bart. H. de V. Steytler.
J. H. Ryan.

SECRETARY: O. F. Brotherton,
for Witwatersrand Township, Estate and Finance Corporation, Limited, Jeppe Arcade
(P.O. Box No. 5036), Johannesburg.

Quarter interest in Freehold Farm, Diepkloof No. 61, 2,084 morgen, situate S.W. of Johannesburg; quarter mynpacht on same farm, 600 morgen in extent.

EAST RAND DEEP, LIMITED.

Capital (in 600,000 shares of 2/- each) £60,000
Issued £50,000

DIRECTORS.
Julius Jeppe (*Chairman*). John Hall Ryan.
Percy Greathead. G. C. Fitzpatrick.
J. A. Cohen.

SECRETARY: O. F. Brotherton,
for Witwatersrand Township, Estate and Finance Corporation, Limited, Jeppe Arcade, Johannesburg.

LONDON COMMITTEE.
L. Erhlich. J. Friedlander.
G. H. Gasson.

LONDON TRANSFER SECRETARY.
E. J. Sloan,
277 and 377, Salisbury House, London Wall, E.C.

Assets.—347 claims on eastern portion of Witwatersrand, and about £40,000 in cash assets.

LEEUWPOORT (AFRICAN FARMS) TIN MINES, LIMITED.
(Registered in the Transvaal.)

Directors power to increase Capital to £300,000
Capital £275,000
Issued Capital... ... ... £162,500
Unissued (partly paid) £112,500

DIRECTORS.
Julius Jeppe, *Chairman*.
J. H. Ryan. B. Southwell. A. G. Gill.

SECRETARY: O. F. Brotherton,
for Witwatersrand Township, Estate and Finance Corporation, Limited, Jeppe Arcade, Johannesburg.

Property. Freehold Farm, Leeuwpoort, No. 938, Rustenburg, in extent 8,325 acres, and mineral rights over 2,307 acres on Rietfontein, No. 940, adjoining Leeuwpoort on the east.

SOUTH AFRICAN GOLD MINES, LIMITED.
(Registered in Transvaal.)

Capital (authorised) in 308,000 shares of £1 each ... £308,000
Issued £179,324
Debentures, £308,000. Interest 5 per cent.
Outstanding, £77,000.

DIRECTORS.
J. Jeppe (*Chairman*). Sir Abe Bailey, K.C.M.G.
J. H. Ryan. Sir Emrys Evans, C.M.G.

SECRETARY: O. F. Brotherton,
for Witwatersrand Township, Estate and Finance Corporation, Limited, Jeppe Arcade, Johannesburg.

LONDON COMMITTEE.
G. E. Lomas. Hon. A. G. Brand.
Ludwig Neumann. Brinsley Fitzgerald.

LONDON TRANSFER SECRETARY.
E. J. Sloan,
277 and 377, Salisbury House, London Wall, E.C.

FRENCH RAND DEEP, LIMITED.
(Registered in Transvaal.)

Capital £500,000
Issued £400,000
Property: 459 claims and water-rights, situated on Witpoortje No. 44, Witwatersrand.

DIRECTORS.
J. Jeppe, *Chairman*.
B. Southwell. J. H. Ryan. P. Greathead.
E. M. Hind.

SECRETARY: O. F. Brotherton,
for Witwatersrand Township, Estate and Finance Corporation, Limited, Jeppe Arcade, Johannesburg.

LONDON COMMITTEE.
Lord Lurgan.
Arnold Friedlander. G. Seymour Fort.

LONDON TRANSFER SECRETARY.
E. J. Sloan,
277 and 377, Salisbury House, London Wall, E.C.

SOUTH FRENCH RAND, LIMITED.
(Registered in Transvaal.)

Capital £400,000
Reserve £100,000
Property: 430 claims on Witpoortje No. 44, adjoining the southern boundary of the French Rand Deep, Limited.
The South African Gold Mines, Limited, holds 170,152 shares.

DIRECTORS.
J. Jeppe (*Chairman*). Sir Abe Bailey, K.C.M.G.
J. H. Ryan. F. R. Lynch.

SECRETARY: O. F. Brotherton,
for Witwatersrand Township, Estate and Finance Corporation.

OFFICES.
Jeppe Arcade, P.O. Box No. 5036, Johannesburg.

VOORSPOED DIAMOND MINING COMPANY, LTD.
(Registered in Transvaal.)

Capital (issued), in £1 shares £405,714

DIRECTORS.
E. Friedlander (*Chairman*) J. Jeppe.
I. Rapaport. L. Rosenfeld.
H. Neuhaus. F. R. Lynch.
H. Eckstein.

LONDON COMMITTEE.
C. Sobernheim. J. Kitchin.
A. J. Sharwood. J. S. Wetzlar.
L. Sutro. L. Joseph.

LONDON TRANSFER SECRETARY.
E. J. Sloan,
277 and 377, Salisbury House, London Wall, E.C.

GEYGERLE, LIMITED.
(Registered in Transvaal.)

Capital £70,000
Issued £52,662

DIRECTORS.
J. Jeppe (*Chairman*). A. G. Gill.
C. Davies. J. H. Ryan.
F. R. Lynch.

SECRETARY: O. F. Brotherton,
for Witwatersrand Township, Estate and Finance Corporation, Limited, Jeppe Arcade, Johannesburg.

LONDON COMMITTEE.
G. S. Fort. Montague Eliot. G. H. Gasson.

LONDON TRANSFER SECRETARY.
E. J. Sloan,
277 and 377, Salisbury House, London Wall, E.C.

Property: Farm Geygerle No. 178, East Witwatersrand.

LACE PROPRIETARY MINES, LIMITED.
(Registered in Transvaal.)

Capital £300,000
Issued (fully paid) £249,480
Unissued (partly paid) £4,520
Reserve £45,000

DIRECTORS.
J. D. Lace (*Chairman*). J. H. Ryan.
J. Jeppe. P. Greathead.
L. Edwards.

SECRETARY: O. F. Brotherton,
for Witwatersrand Township, Estate and Finance Corporation, Limited, Jeppe Arcade, Johannesburg.

LONDON COMMITTEE.
Sir Jas. Heath. A. J. Sharwood.
G. Seymour Fort.

LONDON TRANSFER SECRETARY.
E. J. Sloan,
277 and 377, Salisbury House, London Wall, E.C.

PRETORIA TOWNSHIPS, LIMITED.
(Registered in Transvaal.)

Capital (in 500,000 shares of £1 each) £500,000

DIRECTORS.
Julius Jeppe, *Chairman*.
John H. Ryan. A. C. Stone.

SECRETARY: Ernest Coote,
for Witwatersrand Township, Estate and Finance Corporation, Limited, Jeppe Arcade, Johannesburg.

HEAD OFFICE.
TRANSFER SECRETARY: O. F. Brotherton,
Jeppe Arcade, Johannesburg.

LONDON COMMITTEE.
A. J. Sharwood. Hon. A. G. Brand.
Montague Eliot.

LONDON TRANSFER SECRETARY.
E. J. Sloan,
277 and 377, Salisbury House, London Wall, E.C.

SIMMER EAST DEEP, LIMITED.
(Registered in Transvaal.)

Capital £500,000
In 500,000 shares of £1 each, as follows:
Vendors, for 431 claims on Klipportje £400,000
Working capital (at par) £50,000
Reserve £50,000

DIRECTORS.
Julius Jeppe (*Chairman*). Sir Abe Bailey, K.C.M.G.
H. A. Rogers. J. H. Ryan.

SECRETARY: O. F. Brotherton,
for Witwatersrand Township, Estate and Finance Corporation, Limited, Jeppe Arcade, Johannesburg.

LONDON COMMITTEE.
Lord Lurgan. Brinsley Fitzgerald.
G. Seymour Fort.

LONDON TRANSFER SECRETARY.
E. J. Sloan,
277 and 377, Salisbury House, London Wall, E.C.

WELGEDACHT EXPLORATION COMPANY, LIMITED.

Capital Issued... ... ... £156,750
Leaving 93,250 shares in reserve.
Property: Farm Welgedacht, in extent 5,500 acres, adjoining the farm Geduld on the eastern extension of the Rand.

DIRECTORS.
P. G. Hamilton Carvill, *Chairman*.
T. Fell Dalglish. John H. Ryan. R. L. Davies.

JOHANNESBURG AGENTS.
C. H. Mullins, V.C., C.M.G. John Roy.

SECRETARY: O. F. Brotherton,
for Witwatersrand Township, Estate and Finance Corporation, Limited, Jeppe Arcade, Johannesburg.

LONDON SECRETARY.
H. J. Smith, 264/273, Salisbury House, London Wall, E.C.

WITWATERSRAND LAND AND EXPLORATION COMPANY, LIMITED.
(Registered in Transvaal.)

The Authorised Capital is £180,000
in fully paid shares of £1 each, all held by the African Farms, Limited.
Issued £179,631

DIRECTORS.
Julius Jeppe (*Chairman*) *alternate* A. A. Barker. C.M.G., M.L.A.
Sir Abe Bailey, K.C.M.G. ,, J. Emrys Evans,
A. G. Gill ,, W. H. B. Frank.
J. H. Ryan ,, E. M. Hind.
B. Southwell

SECRETARY AND OFFICES.
O. F. Brotherton,
for Witwatersrand Township, Estate and Finance Corporation, Limited, Jeppe Arcade.
P.O. Box No. 5036, Johannesburg.

This company was registered in the Transvaal on March 10th, 1902, and holds 65 freehold farms, covering 272,435 acres in all.

AFRICAN CLAIM AND LAND COMPANY, LIMITED.
(Incorporated in Transvaal.)

Capital £36,000
Issued £36,000

Julius Jeppe (*Chairman*). Gordon Beves.
J. H. Ryan. Percy Greathead.

SECRETARY: O. F. Brotherton,
for Witwatersrand Township, Estate and Finance Corporation, Limited, Jeppe Arcade, Johannesburg.

WITWATERSRAND TOWNSHIP, ESTATE AND FINANCE CORPORATION, LIMITED.
(Registered in Transvaal.)

Capital £200,000

DIRECTORS.
Julius Jeppe, *Chairman*.
John Hall Ryan. Sir Abe Bailey, K.C.M.G.
Col. Sir. A. Wools-Sampson, K.C.B., M.L.A.
Sir Wm. St. John Carr.

SECRETARY.
Ernest Coote, Jeppe Arcade, Johannesburg.
TRANSFER SECRETARY: O. F. Brotherton.

LONDON COMMITTEE.
G. E. Lomas. Hon. Arthur G. Brand.
Brinsley Fitzgerald. Ludwig Neumann.

LONDON TRANSFER SECRETARY.
E. J. Sloan,
277 and 377, Salisbury House, London Wall, E.C.

RHENOSTER MINES, LIMITED.

(Incorporated in Transvaal.)

Capital £600,000
Issued £495,000
Property: Six diggers' claims and three water-rights on farm Rhenosterspruit No. 16, Klerksdorp district, and interests in other ventures.

DIRECTORS.

Julius Jeppe, *Chairman.*
Col. Sir A. Woolls-Sampson, K.C.B., M.L.A.
J. H. Ryan. Percy Greathead.

SECRETARY: O. F. Brotherton,
for Witwatersrand Township, Estate and Finance Corporation, Limited, Jeppe Arcade, Johannesburg.

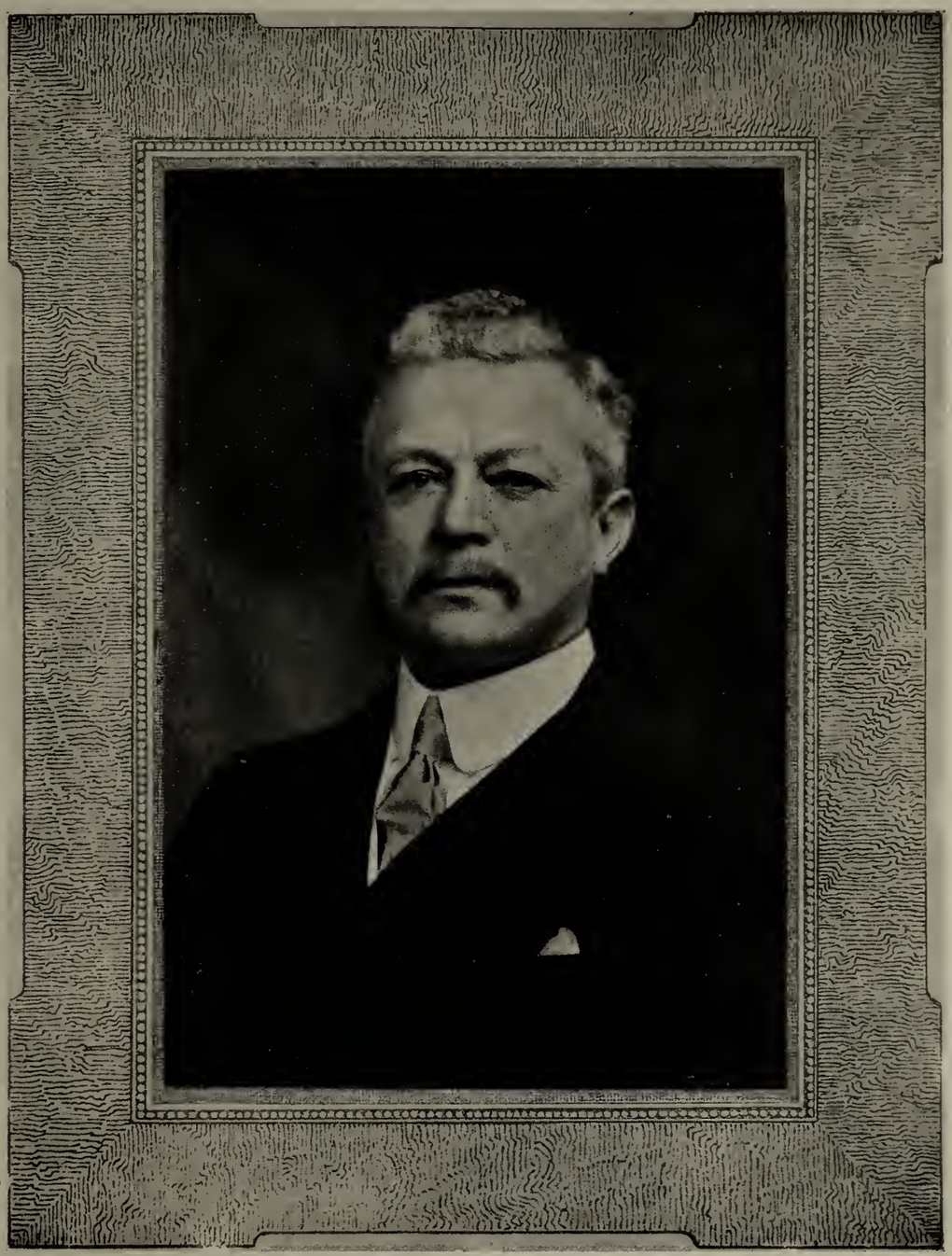
on their holding. Property consists of 66 claims, four machine stands, and one water-right, on the farm Luipaardsvlei No. 8, in the mining district of Krugersdorp.

WELGEVONDEN TIN MINE.

On the company's freehold farm, Welgevonden No. 1772, district Waterberg, having an area of 6,020 acres; active development work has been going on for some time, with very satisfactory results, and the estimated value of the ore developed and at grass is £100,000. A ten stamp battery has been purchased and is in course of erection; crushing is expected to start early in January next.

LEEUWPOORT (AFRICAN FARMS) TIN MINES, LIMITED.

This company was registered on 22nd April, 1912, with a capital of £275,000, of which £162,500 was subscribed for at par to provide for £50,000 cash to the vendors and £112,500



Sir ABE BAILEY

SIR ABE BAILEY'S COMPANIES.

AFRICAN FARMS, LIMITED.

The African Farms, Limited, is one of the largest land owning companies in South Africa. It was originally registered in 1902, with a capital of £25,000, which was subsequently increased to £650,000. Its land holding comprises 197 freehold farms with an area of 1,657,816 acres, mineral rights on seven farms having an area of 97,187 acres, surface rights over two portions of a concession on Swaziland amounting to 9,088 acres.

The company holds 185,000 shares in the Diepkloof Mynpacht, Claim and Estate Company, Limited, the assets of which consist of a one-quarter undivided interest in the farm Diepkloof No. 9, district Johannesburg, as well as a one-quarter undivided interest in the mynpacht, 600 morgen in extent, on the same farm, which is situate south-west of Johannesburg, and adjoins the farm Mooifontein No. 14.

The company holds 24,666 shares in the York Gold Mining Syndicate, Limited, of which the issued capital is £37,000, on which dividends, amounting to £20,966 2s. have been received.

working capital. The property consists of the freehold farm Leeuwpoort No. 938, Rustenburg, in extent about 8,325 acres, and the mineral rights over 2,307 acres of the farm Rietfontein No. 940, adjoining Leeuwpoort on the east.

To date there is on a conservative estimate about 90,000 tons of ore developed and at grass, with a valuation of £277,000. There are six distinct and separate ore bodies being developed, and 14,000 feet of driving and shaft sinking has been accomplished to the end of June.

A 30 stamp battery and tin dressing plant has been ordered, and when crushing commences development will be at least two years ahead of the mill.

The African Farms, Limited, holds a large interest in this company.

SOUTH AFRICAN GOLD MINES, LIMITED.

The capital of this company is £179,324. In 1909 debentures were issued for £308,000, which have since been reduced to £77,000. The principal assets consists of Claims and Mining Ventures in the Central and Western sections of the Witwatersrand.

Shares in subsidiaries and other Rand Mining Companies, principally Crown Mines, Limited, City Deep, Limited, Village Deep, Limited, Witbank Colliery, Limited, Modder Deep, Limited, French Rand Deep, Limited, Simmer East Deep, Limited, Consolidated Langlaagte, Ceylon Lydenburg, etc.

Farm properties consist of interests in the following farms near Leydsdorp in the Lydenburg district:—Roodeval No. 631, Dunotter No. 1388, Vaderlandsche No. 533, Hebron No. 521.

Other Interests of the Bailey Group.

The above list by no means includes all the properties in whose destiny Sir Abe Bailey is a dominant force, but it serves to illustrate the ubiquity of his influence. Directly or indirectly he controls such companies as the Donovan Syndicate, with a capital of £35,000, which owns the freehold of ground adjoining on the west the Turf Club property at Turffontein. The Suburban Township Company, with a capital of £27,000, owns the farm Rietfontein, at Pretoria, and the farm Driefontein, at Johannesburg.

The Rhenoster Mines, Limited, with an issued capital of £495,000, of which £90,000 in cash is still intact, and the company hold a substantial interest in the Leeuwpoort (African Farms) Tin Mines, Limited, and other mining ventures.

The East Rand Deep, Limited, with an issued capital of £50,000. This company holds 347 claims in the fashionable East Rand district on the farm Leeuwpoort.

The Geygerle, Limited, with an issued capital of £52,662, holds the freehold farm Geygerle No. 28, also in the East Rand, in extent 1,530 acres, and adjoins the Welgedacht Exploration Company, Limited.

The Lace Proprietary Mines, Limited, with an issued capital of £249,480, holds the freehold farms Droogefontein No. 447, and Vlakfontein No. 26; also on the East Rand, in extent about 18,870 acres.

WITWATERSRAND TOWNSHIP, ESTATE AND FINANCE CORPORATION, LIMITED.

(Incorporated in the Transvaal.)

Liabilities.

Capital and Share Premium Account appear unchanged at £400,000.

Sundry Creditors and Deposits total £24,716 15s., and show a decrease as compared with the previous year of £607 11s. 1d.

Assets.

The directors, in writing off a total amount of £12,085 2s. 10d., have made ample provision for any shrinkage which may have occurred in values.

Property Account, £230,021 12s. 11d., has been reduced by £559 9s. 7d., owing to sales of freehold of stands, less an amount of £855, being the Corporation's share namely, one half—of the purchase price given for the freehold of Lorentzville Township.

Houses and the Jeppe Arcade have been written down by £6,355 11s. 1d. and now stand at £81,685 11s. 11d., on which amount a fair rate of interest is received.

Investments in Property.—This item having been written down by £2,277 11s. 6d. now stands at £46,977 10s. 2d.

Investments in shares figures at £90,880 4s. 9d. As will be seen by the balance sheet, your share holdings consist mainly of interests in other township and land companies, and all shares have been written down so as to bring them in at their respective values at the 31st December last; an amount of £1,787 2s. 6d. having been written off.

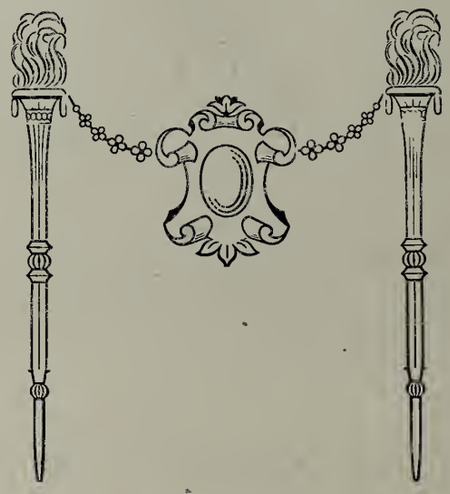
The company owns the freehold townships of Jeppestown, Fordsburg, Wolhuter, North Doornfontein, Bellevue, and Jeppestown South, and the leasehold township of Spes Bona, besides large interests in Malvern and Bellevue East townships. All these properties are embraced by the city of Johannesburg, and form a large and important part of its area. These townships are directly administered from the offices of the company, which, further, is largely interested in Troyeville and Lorentzville. The management of the Pretoria Townships, Ltd., in which it has a large holding, also falls to its care, giving it an interest in the capital of the Union which still further emphasises its position as a township company of magnitude and promise.

Pretoria Townships, Ltd.

The prospects of the Pretoria Townships Company are also most hopeful. That company has spent very large sums in the development of its properties, namely, on Waterkloof and Muckleneuk, and portions of Brooklyn and New Muckleneuk Townships, and it hopes to reap the full benefit of that expenditure. Nobody with any knowledge of the vast wealth and wonderful resources of this country can have any doubt as to the great expansion in the near future of the capital of the Union of South Africa, and it is quite certain that such expansion must principally affect the eastern districts, where the company has not alone Waterkloof, but the two Muckleneuk townships and a portion of Brooklyn.

Malvern Estate Company.

The Malvern Estate Company has a capital of £300,000 and takes its name from a township owned by it. Malvern bounds Belgravia and Jeppestown, and extends beyond Cleveland. Even during the depression, this township made steady progress, probably because of the convenient railway and tramway services which link it to Johannesburg. Many stands were sold and houses built, and with the revival of general prosperity its growth has been accelerated.



THE Ehrlich-Hamilton Group

THE PIGGS PEAK DEVELOPMENT COMPANY, LIMITED.

(Incorporated in England.)

Capital (authorised)	£340,000
Issued	223,226

Property.—The principal property of the Company consists of the mining and other rights on 62 square miles, equal to over 40,000 acres, in Swazieland, about 25 miles south-east of Barberton, on which rich gold-bearing deposits are being worked. The Company also owns 100 claims and mill near Barberton, formerly belonging to the Eagle's Nest Gold Mining Company. Development work is proceeding at the Peak Mine, which has been opened to a depth of 600 feet. 131,865 tons of ore of an average value of over 11 dwts. are developed. Crushing started in August, and regular profits are now being made.

DIRECTORS.

Captain F. B. Lawson, *Chairman*. George Freeman.
Ludwig Ehrlich. Julius Friedlander.

BANKERS.

Union Bank of Scotland, Limited.

SOLICITORS:

Herbert Smith, Goss, King and Gregory.

AUDITOR.

Charles Fox, F.C.A., 11, Old Jewry Chambers, E.C.

CONSULTING ENGINEER.

E. T. McCarthy, M.I.M. & M., &c.

LOCAL BOARD (JOHANNESBURG).

J. Andrew Cohen, *Chairman*.
J. H. Ryan. H. W. Anderson.

GENERAL MANAGER IN SOUTH AFRICA.

C. Hunter, M.I.M. & M.,

SECRETARY AND OFFICES.

William Smith, 10/11, Austin Friars, London, E.C.

JOHANNESBURG SECRETARY AND OFFICES.

H. Williams, City House, Harrison Street.

RECENT PROGRESS AT PIGG'S PEAK.

SUCCESS ACHIEVED UNDER PRESENT MANAGEMENT—EXTRACTION NEARLY DOUBLED—INCREASING PROFIT EXTENSION OF PLANT CONTEMPLATED.

Investors in this country do not concern themselves to any extent with mines at some distance from the chief centre, Johannesburg. Amongst the go-ahead mines, which have made steady progress during the last couple of years, may be cited the Piggs Peak Development Company. It is needless to review the chequered career of its earlier history. Instead of following down the payable ore deposits, drives and cross-cuts were sent in all directions, much money being wasted without obtaining adequate results. Real success has, however, been achieved under the present administration, the gold extraction from the refractory ore has been raised from below 50 per cent. to nearly 90 per cent., profits for the year ending 31st March, 1910, amounted to £14,549 10s., and the following year they rose to £23,689 18s. 3d., whilst the profits for the current year amount to £28,576 12s. 8d. Some few months ago a further increase in the reduction works was made. The expansion was recommended on the strength of constantly increasing ore reserves, and the data now available point to an output of £65,000 per annum. It is impossible to prophesy how long this prosperity may continue, but encouragement is found in the fact that the ore in sight is over four years ahead of the mill. The main stope, indeed, between fourth and fifth levels, is the largest in South Africa. At present development is largely confined to upper levels, because additional reserves are still being disclosed and cost of pumping and hoisting is thereby avoided.

RECENT RESULTS.

Operations for the year ended 31st March, 1912, showed a working profit of £28,576 12s. 8d., and after deducting general expenses in London and South Africa, a net credit to profit and loss of £21,728 1s. 9d. This amount, together with the balance brought forward from the previous year, £979 14s. 6d., has been dealt with by writing off £21,899 19s. 1d. from mine development and carrying forward £807 17s. 2d. to the current year.

MONTHLY RETURNS AT A GLANCE.

The following table gives at a glance the results of crushing operations in recent months:—

Month	Stamps	Tons Crushed.	Total Gold Recovered. Fine ozs.	Per Ton Dwts.	Working Costs per Ton Crushed.	Total Profits £
1910						
April ...	20	2,801	1,116.000	7.969	12 7.47	2,919
May ...	20	2,757	996.619	7.032	13 1.10	2,381
June ...	20	2,750	946.566	6.884	12 8.85	2,220
July ...	20	2,429	965.911	7.953	15 0.67	2,228
Aug. ...	20	2,834	1,026.296	7.242	13 5.60	2,402
Sept. ...	20	2,685	1,105.221	8.232	13 9.50	2,790
Oct. ...	20	2,761	1,050.420	7.609	14 11.23	2,346
Nov. ...	20	2,603	969.750	7.451	15 1.66	2,102
Dec. ...	20	2,515	869.832	6.917	16 5.65	1,582
1912.						
Jan. ...	20	2,655	1,033.383	7.784	16 2.86	2,185
Feb. ...	20	2,458	1,213.343	9.873	16 4.50	3,084
March	20	2,665	1,120.670	8.398	16 1.28	2,555
April ...	20	2,722	1,233.891	8.993	15 6.94	3,078
May ...	25	3,000	1,211.970	8.070	14 3.67	3,002
June ...	25	3,061	1,233.223	8.057	14 1.15	3,080
July ...	25	2,876	1,230.886	8.559	15 0.26	3,069
Aug. ...	25	3,300	1,222.716	8.280	12 4.17	3,156

ORE RESERVES.

In the old Pigg's Peak Mine the ore body is of a quartzitic nature in which sulphides of iron are abundant. The lode is irregular in shape, and although not strictly speaking lenticular, belongs to that class. The containing walls are diorite on the south, and crystalline schist on the north side of the occurrence. Occasional schist is met with in the lode, which is probably an intrusive magma, forced into planes of weakness and subsequently altered by dynamic action. The mineralisation is irregular. One of the more recent stopes, the "Blacksmith Chute," discovered by the present management, has opened out unexpectedly well. High grade ore has been developed in the fourth level during the last two months, and a winze has just been started to the lower levels. This will increase the reserves considerably. A further recent discovery is the extension of the large fourth level stope towards the surface. It seems curious that all these favourable factors remained undiscovered. Old drives are within a few feet of the valuable reserves which are now being opened.

Just recently exploratory work in the 6th level stope old section mine, has revealed the existence of a considerable body of ore to the south of the false footwall, which after extensive sampling gave an average value of 10 dwts. over 40 feet. This body of ore is being opened up, and is deemed by the manager a good augury for the prospect of continuity at depth.

The manager has recently been prospecting other portions of the Pigg's Peak Concession, and his work has resulted in the location of a body of schist intermixed with quartzite about a mile south-east of the Pigg's Peak, and distinct from the auriferous ore bodies at present being worked. Sampling gave an average value of 4.5 dwts. over 20 feet, sampling over 5 foot sections giving values of 8, 3, 3 and 4 dwts. This body of ore is also being opened up with despatch.

NEW SECTION.

The new section lies north of the Pigg's Peak lode and in the crystalline schists. The occurrence is an irregularly mineralised ribbon rock, the gold being precipitated in the more basic sections of the generally acid schists, and where iron in the ferric state abounds. A good deal of cross-cutting and driving has here been done. The future development will largely consist of following the gold chutes which have so far been discovered. These can be better determined when stoping is in active progress and the nature of the auriferous deposit is better understood.

PLANT AND EQUIPMENT.

The mine equipment is all of modern type and in first-class order. The plant consists of a power station, six miles distant from the mine, consisting of 200 kw. generator, 3,000 volt 50

cycles, direct coupled to a Pelton wheel, having the necessary hydraulic and electrical governors. This power plant is in perfect order, quite new, and ranks amongst the best installations of its kind in South Africa. The minimum volume of water is some 2,000 cubic feet per minute, with a fall of over 200 feet, giving a theoretical horse power of 750. The fall can be at least doubled by leading the water a few hundred yards to the east. The power line is in good working order. The three separate mine sections, now opened up, have all been equipped with substantial headgears, electric hoists, efficient pumping plant, and good general haulage arrangements. Electric light has been installed in the main tunnels, and at the principal loading stations. Convenient arrangements have been made to connect the mines, from the 4th level adits of both old and new sections, and which two converge at the adit mouth, with the reduction works. The ore is conveyed in trucks direct from the main 4th level adit into the battery ore bins. The reduction works consist of a compact up-to-date 25 stamp battery, two rock breakers, classifiers, tube mill, concentrators, calciner, Brown's agitator, sands and slimes plant, and extractor house, all of the latest design and well arranged. Full advantage has been taken of the natural slope of the well-chosen site.

Gold Recovery.

Milling operations were conducted from July to December, 1908, and during that period 7,339 tons were crushed, but only 43.8 per cent. of the gold contents were recovered, namely, 2,048 ounces. The methods of extraction had to be changed, and the whole reduction plant had to be constructed *de novo*, with suitable additions, etc. An all-sliming process was aimed at. The experiment was eminently successful. In a recent report on the recovery works at the mine, Mr. J. R. Williams, the well-known metallurgist, wrote, *inter alia*:—"I have carefully gone into the treatment (of old section of ore) and have no hesitation in saying that the work throughout is of a first-class nature, and, with the exception of calcining the concentrates before putting them through the pan (which is now being done) I cannot suggest any modification of the treatment, which is giving a very high and satisfactory percentage of extraction."

Agricultural Resources.

A description of the true merits of farming possibilities on Pigg's Peak is unnecessary here. Suffice to say that, according to the latest reports, the live stock appeared to thrive exceedingly, that wattle plantations looked in good condition, the soil is very fertile, and climatic conditions are in favour of reaping good crops. The general manager is fully alive to any advantages derivable from the favourable natural conditions, and has experimentally made successful tests with a view of increasing the company's revenue. Mealie plantations are doing well, whilst experiments in growing tobacco gave good results.

Eagle's Nest.

In addition to the large property, exceeding forty thousand acres, owned in Swaziland, the company possesses an equipped mine in the Transvaal, known as the Eagle's Nest, situated in the Barberton district. An exceptionally well-erected 20-stamp battery in perfect condition is on the property. Curiously enough, this was constructed by a former company, before the existence of a mine had been established. The present management of the Pigg's Peak Company recently restarted work, and developments point to the probability of an extensive ore deposit existing at Eagle's Nest. In a new adit the last 70 feet driven averaged 7 dwts. over a width of 7 feet. The ore is refractory and the laminated ore body contains layers of carbonaceous shale. In addition, it is a highly pyritic, complex ore, containing an appreciable quantity of arsenical pyrites. If satisfactory metallurgical results can be obtained, vigorous exploration will, no doubt, be undertaken. The lode is in a high hill, and ore can be cheaply extracted by adit levels and conveyed by mechanical aerial incline haulage to the battery. It would be premature to say more about Eagle's Nest than offering the opinion that it is deserving of careful attention and promises to develop into a substantial asset of the Pigg's Peak Company. The position of the Pigg's Peak Development Company is briefly this. Three separate gold occurrences have been discovered and partially explored. As a result an ore reserve has been exposed, which, counting only two of these mines, is now over four years ahead of the milling capacity. Further development is sure to increase this tonnage. Gold has been proved to exist on other portions of the mineral belt, and although no opinion can be expressed till more work is done, it cannot be denied that the company has promising possibilities with regard to hitherto undiscovered gold occurrences. The Eagle's Nest mine, in the Barberton district, is also full of promise, and, assuming a satisfactory solution of the metallurgical problem, will pay handsomely. One of the leading Rand mining houses is interested in a very similar occurrence in the district, and claims to have solved this problem, and the Piggs Peak Company hopes to profit by their experiments.

Prospecting operations are now in full swing on the recently acquired Ruby Creek Concession, which embraces an area of approximately 20,000 acres, and the preliminary work, though hampered somewhat in the initial stages by labour difficulties, have so far proved most encouraging—the first point attacked revealing a five feet reef which pans 14 dwts.

THE LUIPAARD'S VLEI ESTATE AND GOLD MINING COMPANY, LIMITED.

Capital, in £1 shares £560,000
Issued Capital £472,012

Number of Claims 797, besides the freehold of the farm Luipaard's Vlei No. 8, in extent 6,500 acres, on which the company has a township and a large plantation of trees. Situated on the West Rand.

Number of Stamps 60

And three Tube Mills.

Directors.

Alexander Davidson. (*Chairman*)
W. Dettelbach.
H. D. Boyle.
F. H. Hamilton.
Leigh Hoskyns.
James Neill.

Trustees for Debenture Holders.

Ludwig Ehrlich. Leigh Hoskyns.

Offices.

10 and 11, Austin Friars, London, E.C.

Secretary: Arnold F. Baynes.

Local Committee (South Africa).

J. Andrew Cohen (*Chairman*).
S. C. Black. W. P. Taylor. G. C. Fitzpatrick.

Manager: Charles B. Saner, M.I.M.M., M.I.M.E.

Local Secretary.

H. Williams, P.O. Box 97, City House, Harrison Street, Johannesburg.

THE NEW LISBON-BERLYN, LIMITED.

(Incorporated in England.)

Capital (Authorised and Issued) £115,625 17 6
In 925,007 Shares of 2s. 6d. each (fully called up).

Directors.

Captain F. B. Lawson, *Chairman*.
Edward W. Lane.
Major R. P. Cobbold.
Edward W. Cox-Moore.

Bankers.

London City and Midland Bank, Limited, 52, Cornhill, E.C.

Solicitors: Spyer and Sons.

Auditors: C. F. Burton, Sewell and Co.

Consulting Engineer.

E. T. McCarthy, M.I.M. & M., &c.

Secretary and Offices.

William Smith, 10 and 11, Austin Friars, London, E.C.

Local Representative (Johannesburg).

J. Andrew Cohen.

Offices (Johannesburg): City House, Harrison Street.
Mine Manager: D. R. Colman, M.I.M.M.

THE H. E. PROPRIETARY, LIMITED.

(Incorporated in England.)

Capital (Authorised) £150,000
Issued 130,200

Directors.

F. H. Hamilton, *Chairman*. Captain F. B. Lawson.
L. Ehrlich. A. L. Secretan.

Bankers.

Parr's Bank, Limited, 52, Threadneedle Street, E.C.

Solicitors: Spyer and Sons.

Auditors: Craggs, Turketine and Co.

Consulting Engineer: E. T. McCarthy, M.I.M. & M., &c.

Secretary and Offices.

William Smith, 10/11, Austin Friars, London, E.C.

Local Committee (Johannesburg).

J. Andrew Cohen. J. H. Rainier.

Secretary and Offices (Johannesburg).

H. Williams, City House, Harrison Street.

LUIPAARDSVLEI ESTATE AND G.M. CO.

Improving Profits—Profitable Ore Reserves Close on a Million Tons—The Company's Financial Position.

Amongst those mines which are rather outside the control of the large Rand groups, the Luipaardsvlei Estate and G.M. Co. has always attracted a large amount of attention. The head offices of this concern are in London. Messrs. L. Ehrlich and Co. are interested, and the local management is entrusted to a local committee.

Returns to Date.

To go back a little into the history of the company, it may be recalled that in accordance with modern crushing methods a new 60 stamp mill of heavy pattern (each head weighed 1,630 lbs.) and three tube mills commenced crushing in April, 1906. For the year ending with June 30th returns since that date have been as follows:—

	Stamps.	Tons milled.	Sorting per cent.	Revenue.	Profit.
1907	60	166,654	13¼	£247,389	£77,282
1908	60	185,579	14½	255,834	79,851
1909	60	197,923	15¾	232,052	53,411
1910	60	198,943	16	197,056	10,683
1911	60	204,022	17.1	209,443	27,327
1912	60	199,144	18.06	199,088	29,028

It will be observed from the above that the 1912 profit is better than that secured during the preceding twelve months, although it falls substantially below the amounts earned in previous years.

A Large Proposition.

In regard to the Luipaardsvlei Estate, it should be borne in mind that up to the present the Company has only dealt with the outcrop portion of its ground to the west. The number of claims worked out by the Company to date is comparatively insignificant, and there still remain untouched 516 claims on Main Reef, 566 claims on South Reef, and 70 claims on Battery Reef. The life of the mine is, therefore, a long one, and, having regard to the extent of unexplored ground, it would seem that there is every chance of further rich chutes being discovered in the property, and of the policy mooted some time ago of increasing the reduction plant being a thoroughly justified move. In 1907 and 1908 the Company was enriched by reason of the working of a rich chute of ore, but this, it appears, has been worked out, and the management is now engaged in endeavouring to locate other rich chutes. Several of the more important levels, notably the 10th, 14th, 16th, 18th, 20th, and 21st, are now each showing better values in the eastern drives. The 19th level West Main Reef winze is showing good values. By the acquisition of the Windsor G.M. Company's property and assets in April, 1909, the Company largely increased its scope and prospects, and apart from the two separate blocks of Mynpacht ground, the Company now owns a compact block of claims extending right along the outcrop section from the eastern boundary of the Lancaster West and York Mines to the western boundary of the French Rand.

Recent Development.

The total tonnage fully developed at the 30th June, 1912, was estimated at 476,175 milling tons of an average assay value of 5.55 dwts. per ton, and 303,417 tons of low grade ore of an average assay value of 2.790 dwts. per ton. The ore reserves are at present being checked and the figures given above are subject to adjustment when check computations are completed.

The developments in the mine, especially in the lower levels show a substantial improvement during the past two months. In the 21st main cross cut South the Main Reef was struck early in August, showing values on first sampling of 10 dwts. over 68 inches, milling value, whilst second sampling gave results equal to 9.3 dwts. over 67 inches milling value at the east face and 7.3 dwts. over 68 inches milling value at the west face. Later in the month in extending the 14th level East Drive, values of 36 dwts. over 35 inches for a distance of 35 feet were encountered. Generally the development between the 19th and 20th levels west proved the existence of some very rich Main Reef, and it is reasonable to assume that given a continuance of the improvement in development, profits will reach a higher level, when probably the Board will consider the advisability of increasing the tonnage treated to 20,000 tons per month.

The Financial Position.

From the last published balance sheet it will be seen that the amount at the credit of Profit and Loss Account for the year 1911 is £23,310 16s. 4d., and this amount, added to the sum already standing to credit of Profit and Loss Account, increases the same to £95,377 8s. 3d. In compliance with the recommendation of the manager the sum written off for depreciation was £14,768 17s. 11d., leaving a balance of £80,608 10s. 4d. to be carried forward. A considerable amount of this working profit has been devoted, as has been the case during the last three years, to the expenditure required for machinery, surface works and development, and it has been unnecessary to make use of the temporary loan which was arranged for as stated in last year's report. The debenture debt which stood at £117,240 on the 30th June, 1911, has been reduced by redemptions and purchases to £103,920 at date.

The Estate Assets.

A few words remain to be said under this heading since the estate of the company is a very valuable asset. The revenue from the estate is satisfactory, and growing a little, whilst from year to year the value of the company's extensive tree plantations is increasing. The number of claims paying licences are over 4,300, half the payment going to the Government and half to the company, whose proportion amounts to £10,000 a year. The homesteads on the estate belonging to the company are let at fair rentals, and some revenue has recently been coming in from stone quarries on the estate. The population is increasing, and building goes on accordingly, especially along the northern part of the estate, through which the railway runs, and where the Krugersdorp station is situated. Taken altogether the position of the company to-day may be said to be an improving one, and both in regard to underground disclosures and finances the position of this West Rand concern appears to be satisfactory.

THE Lewis & Marks Group

THE AFRICAN AND EUROPEAN INVESTMENT COMPANY, LIMITED.

Capital, in £1 shares... ... ... £1,275,000
Issued £1,153,944
Property.—1,270,183 acres in various parts of Transvaal, and large share interests in South African Mining and Estate Companies.

DIRECTORS.
Isaac Lewis, *Chairman.*
H. D. Lewis. S. Marks.
C. F. Rowsell. Julius Weil.
J. B. Hilliard.
G. Falcke. A. C. Mallinson.

HEAD OFFICE: Johannesburg.
MANAGER AND SECRETARY.
A. D. Owen, Threadneedle House, Bishopsgate, E.C.
ASSISTANT MANAGER AND SECRETARY.
G. D. Massey, Lewis and Marks Building, Johannesburg.

THE RHODESIAN GOLD MINING AND INVESTMENT COMPANY, LIMITED.

Capital, in £1 shares (all issued) £300,000
Property—Interests in about 900 gold mining claims in Southern Rhodesia (including the Bernheim and Pretty Polly Mines); a freehold farm of 6,484 acres; and large share interests in the Lonely Reef Gold Mining Company, Sabi Gold Mining Company, Cam and Motor Company, etc.

DIRECTORS.
C. F. Rowsell, *Chairman.*
Isaac Lewis. George Pauling.
G. R. Lewis.
SECRETARY AND OFFICES.
A. D. Owen, Threadneedle House, Bishopsgate, E.C.
GENERAL MANAGER IN BULAWAYO.
Dr. W. T. Pauling.
CONSULTING ENGINEER.
C. B. Kingston.

THE LONELY REEF GOLD MINING COMPANY, LIMITED.

Capital, in £1 shares £325,000
Issued Capital... ... ... £271,007
Property.—The Lonely Reef Mine, comprising 174 claims in the Bembesi district, Southern Rhodesia. The ore reserves at September 30, 1911, were estimated at 127,161 tons of an average value of 1 oz. 2 dwts. 10 grs. A new milling plant—capable of treating 4,000 tons per month—has recently been erected, and is now in full working.

DIRECTORS.
C. F. Rowsell, *Chairman.*
Isaac Lewis. George Pauling.
W. F. Andrewes. Henry D. Lewis.
Mons. H. Bossuat. Mons. L. P. Bartholin.
G. R. Lewis.
SECRETARY AND OFFICES.
A. D. Owen, Threadneedle House, Bishopsgate, E.C.
GENERAL MANAGER IN BULAWAYO.
Dr. W. T. Pauling.

THE VEREENIGING ESTATES, LIMITED.

Capital, in £1 shares... ... ... £730,580
Property.—The Company owns an estate, consisting of 49,065 acres, along the north side of the Vaal River in the Transvaal, and 77,621 acres along the south side of the Vaal River in the Orange Free State, making a total of 126,691 acres; also nine building stands in Johannesburg. Two large collieries (the Central and Cornelia) are on the property.

DIRECTORS.
J. Emrys Evans (C.M.G.), *Chairman.*
Isaac Lewis, A. C. Mallinson, E. S. Marcus, Samuel Marks.
LONDON COMMITTEE.
Henry D. Lewis. C. F. Rowsell.
SECRETARY: W. Mallinson, Vereeniging.
T. Aspling, London.
HEAD OFFICE: Vereeniging.
LONDON OFFICE.
Threadneedle House, Bishopsgate, E.C.

TRANSVAAL FARMS AND FINANCE COMPANY, LIMITED.

Capital, in £1 shares £37,000
Property—Farms in the Pretoria and Rustenburg districts of the Transvaal.

DIRECTORS.
Isaac Lewis. Barnet Lewis. C. F. Rowsell.
SECRETARY AND OFFICES.
T. Aspling, Threadneedle House, Bishopsgate, E.C.
LOCAL REPRESENTATIVE: G. D. Massey.

THE SABI GOLD MINING COMPANY, LIMITED.

Capital, in £1 shares (all issued) £200,000
Property—The Sabi Mine, consisting of 58 claims in the Belingwe district, Southern Rhodesia. The mine is now being actively developed. The present milling plant consists of a 10-stamp battery, but this will be remodelled and enlarged as soon as sufficient ore reserves have been developed to justify crushing on a large scale.

DIRECTORS.
C. F. Rowsell, *Chairman.*
Isaac Lewis. Frank Johnson.
Henry D. Lewis.
SECRETARY AND OFFICES.
A. D. Owen, Threadneedle House, Bishopsgate, E.C.
GENERAL MANAGER IN BULAWAYO.
Dr. W. T. Pauling.

THE NEW RHODESIAN REDUCTION COMPANY, LIMITED.

Capital £50,070
Divided into 50,000 Ordinary Shares of £1 each and 1,400 Founders' Shares of 1s. each.
Issued Capital... ... ... £20,091
20,021 Ordinary Shares and 1,400 Founders' Shares.
Property—A half-interest in the Pretty Polly Mine (Gwelo district), and options over certain claims in Rhodesia.

DIRECTORS.
C. F. Rowsell, *Chairman.*
Isaac Lewis. George Pauling.
SECRETARY AND OFFICES.
A. D. Owen, Threadneedle House, Bishopsgate, E.C.
GENERAL MANAGERS IN BULAWAYO.
Dr. W. T. Pauling and Mr. H. J. Speed.
CONSULTING ENGINEER.
A. H. Ackerman.

THE EAST RAND MINING ESTATES, LIMITED.

Capital, in £1 shares £500,000
Issued Capital £450,000

Property—Interest in freehold farms in the Heidelberg and Pretoria districts of the Transvaal, including Grootvlei No. 45 (adjoining Geduld), Palmietkuil 61 (which adjoins Grootvlei), Rietvlei 383, and Zounderfont 283, all on the eastern extension of the Rand and Vlakfontein 65, in the Nigel district. The freehold of the Company extends to about 20,000 acres, and it has in addition large shareholdings in its subsidiary companies, the Grootvlei Proprietary Mines and Modderfontein Proprietary Mines.

DIRECTORS.
C. Guy-Pym. Barnet Lewis.
Isaac Lewis. Charles F. Rowsell.

LOCAL COMMITTEE—JOHANNESBURG.
Samuel Marks. Geo. Falcke.

SECRETARY AND OFFICES.
Alfred D. Owen, Threadneedle House, Bishopsgate, E.C.

THE GROOTVLEI PROPRIETARY MINES, LIMITED.

Capital, in £1 shares £400,000
Issued £360,250

Property—The mineral rights (except coal) over whole of farm Grootvlei 45 (Heidelberg), 7,200 acres in extent. Farm has been been proved by bore-holes which show Van Ryn Reef to extend beneath the whole of farm.

DIRECTORS.
S. Marks, I. Lewis, A. C. Mallinson.

LONDON COMMITTEE.
W. Gwynne Evans. C. F. Rowsell.

HEAD OFFICE: Johannesburg.

LONDON SECRETARY AND OFFICE.
A. D. Owen, Threadneedle House, Bishopsgate, E.C.

THE ROBERTS VICTOR DIAMONDS, LIMITED.

(Registered in Transvaal 12th January, 1906.)

Capital, in £1 shares £160,000
Of which 10,000 shares in reserve.
Subscribed Working Capital £35,000
(17,500 shares issued at £2.)

DIRECTORS.
S. Marks.
C. H. J. Roberts. J. Emrys Evans.
Sir J. G. Fraser. M. Dold.
Isaac Lewis. C. F. Rowsell,
S. Marks.

HEAD OFFICE AND SECRETARIES.
African and European Investment Company. Johannesburg.

LONDON COMMITTEE.
G. E. Duveen and B. D. Godlonton.

LONDON TRANSFER OFFICE.
Threadneedle House, Bishopsgate, E.C.

SECRETARY.—T. Aspling.

THE MODDERFONTEIN PROPRIETARY MINES, LIMITED.

Capital, in £1 shares £350,000
Issued Capital £300,000

Property.—Freehold of Farm Modderfontein No. 46 (Pretoria), on extension of East Rand. Farm proved by boreholes.

DIRECTORS.
J. Schlesinger, *Chairman*. A. C. Mallinson.
W. P. Taylor. R. M. Connolly.
A. Friedlander. H. D. Lewis.

LONDON COMMITTEE.
J. Friedlander. C. F. Rowsell. A. A. Rothschild.

HEAD OFFICE.
Johannesburg.

LONDON SECRETARY AND OFFICES.
A. D. Owen, Threadneedle House, Bishopsgate, E.C.

THE SWAZIELAND CORPORATION, LIMITED.

Capital, in 10s. shares £200,000
Issued (400,000 shares) £200,000

Properties.—In Swazieland: Mineral concessions over about 800 square miles.

DIRECTORS.
Bernard C. Molloy, *Chairman*.
A. B. Randall. Isaac Lewis.
H. D. Lewis. C. F. Rowsell.

LONDON SECRETARY AND OFFICES.
T. Aspling, Threadneedle House, Bishopsgate, E.C.

SOUTH AFRICA.
Local Committee, Johannesburg:
H. D. Lewis. S. Marks.
Manager in Swazieland: Allister M. Miller.

THE TRANSVAAL ESTATES AND DEVELOPMENT COMPANY, LIMITED.

Authorised Capital £1,000,000
Issued £985,630
Reserve £14,370

DIRECTORS.
Francis Joseph Dormer, *Chairman*.
George Middleton Kiell. George Reed, M.D.
Isaac Lewis. Charles Frederick Rowsell.
Henry David Lewis. Alfred Robert Stephenson.

MANAGER AND OFFICES IN THE TRANSVAAL.
W. M. Brown, Marshall Square Buildings, Johannesburg.

SECRETARY AND OFFICES.
H. Braimbridge, 4, London Wall Buildings, London, E.C.

ROBERTS VICTOR DIAMONDS: CONSULTING ENGINEER'S REPORT.

A CONCISE REVIEW OF THE POSITION.

In the course of his annual report, the Consulting Engineer of the Roberts Victor writes: The following is an outline of the work done on your property since the date of the last annual report:—Mine: The chambering of blue ground has been carried on from the 194 feet to the 314 feet levels, and all the available payable ground above the latter level has been extracted. At the present time about 13,000 loads of blue still remain dumped at the surface; this will be washed at the rate of about 500 loads per day until it is exhausted. During the period referred to some 4,600 feet of driving and sinking has been accomplished. The following statement gives the details of this development work:—314 feet level: South-west of air shaft, drives 665 feet; north-west of air shaft, drives 245 feet; No. 1 mine, drives 188 feet. 394 feet level: Fissure (drives), 2,423 feet; winze from 314 feet to 394 feet level (drives), 80 feet; new area (drives), 345 feet; 634 feet level (drives), 299 feet; air shaft (sinking), 124 feet; 100 feet level, new area (drives), 75 feet; No. 35 shaft and drives (drives), 81 feet; No. 36 shaft and drives (drives), 71 feet. Total, 4,596 feet. The area of fissure which has been opened up on the 394 feet level from the old mine equals about 34.5 claims. Plan No. 2683, which is attached hereto, gives the particulars of the development, and the values obtained from the test washings. It will be noticed that the area forms a long, irregular figure, extending over a length of about 600 feet, and averaging about 60 feet in width. The values, according to the test washings, appear to increase fairly consistently from north-east to south-west, the average of the whole number of tests, representing 2,959 loads washed, being 30 carats per 100 loads, valued at 19s. per carat throughout. The value per load on the above basis would be about 5s. 8d., and, as the working costs on a body of this kind could not be less than 7s. 6d. or 8s. per load, this part of the mine must be considered unpayable. Should the narrow, and richer part of the fissure, only, be worked, the costs would be considerably increased, and the prospects would not be improved to any appreciable extent. 514 feet and 634 feet levels: This part of the mine was dewatered. No development was done on the 514 feet level during the year. On the 634 feet level a certain amount of driving was carried out; this is shown on plan No. 2681. The development throughout was in ground of a dirty nature containing a very large proportion of huge boulders, estimated at 50 per cent. or 60 per cent. of the whole. The area exposed by the development on this level equals 4.2 claims. From it 430 loads were washed, yielding 230 carats, equal to 53.4 carats per 100 loads, but the diamonds were not of a high quality. A large quantity of water was encountered during the progress of the work, and there is every indication that the quantity would increase with greater depth. All mining operations have now been suspended in the mine. The electrically driven pumps at the bottom of the No. 1 shaft are still in position, and the water is being kept down to the 314 feet level. No. 1 shaft: The later chambering operations caused a considerable subsidence of ground in the immediate vicinity of this shaft, but so far the shaft itself has not been affected. With a view to protecting the shaft as far as possible—in case it should at any future time be required—waste ground is now being filled into the subsided area. 314 feet level under No. 1 area: The development done here is shown on Plan No. 2681. This work exposed two or three small fissures or veins of very dirty blue ground, which were so largely mixed with shale, etc., as to render it impossible to get sufficient blue ground. To further prove this part of the mine, a winze was sunk from the 314 feet level to the 394 feet level; the plan previously referred to showing the development at the latter level. 394 feet level, No. 1 area: In this case also the fissure was found to be most irregular and broken, and, although the body of blue was of larger dimensions than in the level above, it was of the same dirty character. 652 loads of ground picked out from the drives yielded from the test washing 132¼ carats, or 20.3 carats per 100 loads. On this basis this area is also unpayable. In view of the foregoing results it was decided to discontinue work in this section of the mine. No. 1 area (surface): From this area about 412,000 loads of tailings and overburden have been removed, and 71,859 loads of yellow ground have been extracted. The area of yellow ground exposed at the 60 feet level equals 19.3 claims. There is reason to believe that the area of the fissure will be considerably increased to the north and south, in both of which directions the stripping of overburden is being carried on. In all probability the areas Nos. 1 and 2 will be found to connect, but the width of the fissure between the two points has not yet been determined. At the present time, yellow ground is being extracted down to the 80 feet level, and preparations are being made to carry the open-cast workings down to a depth of 150 feet. The decomposed nature of the shale walls necessitates the removal of a very large quantity of overburden. The estimated quantity of yellow remaining (in January) in the No. 1 area

down to the 100 feet level—without allowing for any longitudinal extension of the fissure—is calculated at 37,000 loads, and from the 100 feet to the 150 feet levels—taking the area at 10 claims—at 43,000 loads. The ground in this neighbourhood should yield from 40 to 50 carats per 100 loads. No. 2 area: From this area about 58,000 loads of tailings and overburden have been removed, exposing yellow ground over an extent of 4 claims. At this point the fissure appears to be widening out at the 40 feet level, and there is every reason to believe that it will be found to connect with the No. 1 area, which is situated about 800 feet to the north-east. Should this prove to be the case, a very large quantity of yellow ground will be available if the fissure maintains a working width. The yellow ground exposed in the lower part of this area is precisely similar in appearance to that now being got from the No. 1 area, and will probably prove to be equally valuable. Within the next week or two, sufficient ground should be available for the test washing. The re-installation of the grease tables has proved of great benefit to the company, and besides reducing the number of sorters required, has tended to improve the recovery of diamonds in several ways. The machinery and plant have been maintained in a high state of efficiency during the year. In conclusion, I beg to say that I consider great credit is due to Mr. Parsley for the able and energetic manner in which the company's affairs have been handled during his term of management.

STRIKING PROGRESS AT THE SHEBA.

Points from the Reports of the Manager and the Consulting Engineer.

The General Manager of the Sheba, Mr. H. B. White, reports as follows, for the six months ended 31st December, 1911:—Mining: During the period under review ore has been extracted as follows: Zwartzkopje, 23,978 tons, value 13.39 dwts. per ton; Insimbi, 1,293 tons, value 6 dwts. per ton; Southern Cross, 1,645 tons, value 7.1 dwts. per ton; Birthday, 5,689 tons, value 10.76 dwts. per ton; Old Sheba Mine, 680 tons, value 4 dwts. per ton; total, 33,285 tons. Development: The following footage has been done:—July, 656 feet; August, 959 feet; September, 857.59 feet; October, 723 feet; November, 733.5 feet; December, 488.5 feet; total, 4,417.5 feet. Distributed as under:—Zwartzkopje: 2,641.5 feet; Insimbi, 340 feet; Southern Cross, 155 feet; Birthday, 1,132 feet; Z.K.E.B., 149 feet; total, 4,417.5 feet. The result of the above development is as follows:—Zwartzkopje: This has continued the chief producer, and 72 per cent. of the total tonnage crushed has come from here during the period. In spite of this the ore reserves here have been maintained and added to. On Nos. 2, 5 and 7 levels development has been satisfactory, but Nos. 1, 3 and 4 have not as yet been successful owing to their not having advanced sufficiently to meet what I consider is the main ore chute. Having only a limited amount of power available for development work, preference has been given to those levels which would give the earliest results. Insimbi: It has only been possible to conduct development operations here on a small scale; the result, however, has been satisfactory and has added to the ore reserves. There is ample scope here for further successful development if sufficient labour were available for the purpose. Intombi: This awaits further development, good values being in sight in the bottom of the mine. Southern Cross: Nothing has been added to the ore reserves here during the period on account of my being unable to open up the bottom level through insufficient labour. Birthday: All the pay rock in sight has been extracted, but further exploratory work will be undertaken when possible. Ore Reserves: I estimate the ore reserves at the 31st December, 1911, as follows:—Zwartzkopje, 102,000 tons; Insimbi, 17,000 tons; Intombi, 2,000 tons; Southern Cross, 6,000 tons; total, 127,000 tons. The ore reserves at 30th June, 1911, were estimated at 104,250 tons. Gold extraction: The following is the result for the six months ended 31st December, 1911:—Total tons treated, 33,285 tons; average assay value of ore per ton, 12.47 dwts. Gold extracted, inclusive of addition to reserve account, 16,880.050 fine ozs. Extraction: By amalgamation, 32.34 per cent.; by cyaniding, 48.99 per cent.; total 81.33 per cent. Gold held in reserve as at 31st December, 1911, 1,816.039 fine ozs. Surface: Repairs have been effected at the generating station and fifty stamps have been equipped for being electrically driven. During November some of these commenced service, but owing to the dryness of the season lowering the water supply at the generating station, I have since been precluded from working more than thirty of these stamps. Machinery and plant generally have been maintained in a good state of repair. Native labour: This has fallen short of my requirements throughout the half year, but it is reasonable to expect that the supply will be augmented at an early date.

The Consulting Engineer, Mr. G. C. Fox, visited both the Sheba and Rosetta properties during February, and the following is a synopsis of his report:—

Sheba.—*Zwartzkopje.*—The prospects here are, in my opinion, very satisfactory; a large body of highly payable ore has been already developed on the second, fifth and seventh levels on the fracture underlying the chert bar in the Western part of the mine, and there is every reason to believe that the same ore chute will be encountered on the other levels when sufficient development has been done. The supply of native labour has not been sufficient to permit of the simultaneous development of all the levels, and to maintain the supply of ore to the mill. Owing to the shortage of labour it has been found necessary to stop some of the development drives, and place the machine drills in the stopes for the purpose of breaking ore for the mill. While on the mine I visited, with the manager, the various stopes and development drives, and agree with him as to the ore reserves already developed. *Insimbi.*—In this mine a certain amount of development has been done on both the Eastern and the Western sections. On the Western end of the mine, at the fifth level, the development has disclosed a quantity of payable ore beyond the point at which the payable values were formerly supposed to cease. Development has been temporarily suspended here, but so soon as labour, or power is available, work will be resumed. On the Eastern side of the mine, at the fifth level, the ground is disturbed by the Edwin Bray dyke, but there is reason to believe that further work will prove the existence of the Zwartzkopje fracture, and in all probability the pay chute will be picked up either at this level or on one of the lower ones. *Southern Cross.*—In this mine development work is proceeding, and some 6,000 tons of highly payable ore have already been opened up. The chute is about 300 feet long and is now being developed by means of two winzes below the second level; at the time of my visit the winzes had reached a depth of about 50 feet, and were in ore of value equal to that in the level above. The ore throughout in this mine equals from 10 to 12 dwts. over about four feet. *Birthday.*—Work has been temporarily stopped here for want of labour; so soon as this is available development will be resumed. *General.* The rainfall has this year been far below the average, consequently the river is very low. On this account the amount of power available from the generating station has only been sufficient to run about 30 stamps electrically. The mill plant has been well maintained, and, with the exception of some pile blocks which have become rotten, is in good condition. The Wilfley tables which have been installed are doing excellent work, and the benefit of the change from Frue vanners is now being felt. A number of improvements have been made by Mr. White during the past six months.

Rosetta.—*Blue Reef.*—The development work done on and below the third level, during the last month or two, has disclosed no payable ore; the known ore bodies on this level are being rapidly exhausted, and there appears to be very little prospect of more payable ore being discovered in this part of the mine. *White Reef.*—Within the last few weeks a payable body of ore has been discovered on the White Reef line to the east of the point where it had previously been worked. This part of the old workings had previously been sampled, but gave no values A small amount of work in the cutting disclosed payable values and led to a further examination, which resulted in payable values being found, within a few feet of the old faces. At the present time a payable length of about 70 feet has been opened up along the strike and to a depth of about 50 feet. The reef averages about 3 feet in thickness, and about 9 dwts. in value. Driving has been commenced to ascertain the extent of the values along the strike. Until these drives have been advanced some distance, and a certain amount of sinking done, it is impossible to form any estimate of the quantity of ore which will be available from this source. In any case it appears reasonably certain that the quantity will be sufficient to keep the mill running for the next month or two, and it is possible that the pay chute may be found to lengthen with increasing depth. and to carry payable values below the point where these have ceased in other parts of the White Reef.

PROSPECTS OF THE AFRICAN AND EUROPEAN INVESTMENT CO.

Brief Review of a Many-sided Undertaking.

The interests of the African and European Investment Co. are many and diverse. The area now owned by the company is 600,134 morgen (exclusive of 119,133 morgen in British Bechuanaland held through the Bechuanaland Farms, Limited), the total area being equivalent to 1,270,183 English acres. The company, with three exceptions, owns the mineral rights over the whole of its 159 farms in the Transvaal and Orange Free State.

Active and continuous progress is being made in the development of agricultural interests in the Transvaal. The estimates of expenditure of the Union Government for the current year show that considerable sums are being set aside for irrigation loans to farmers and public bodies, for water boring, and for other agricultural purposes, whilst the imports into the country of agricultural machinery, fencing material, land fertilisers, etc., during the past year show very large increases. The investigations carried out by the Department of Agriculture to ascertain the causes of the cattle and stock diseases that have hitherto been prevalent in the country have met with satisfactory results, and there is little doubt that these diseases can now be successfully treated and that they will be ultimately eradicated.

A marked feature of the year has been the rise in the value of land, farming operations having been more successful than ever before. The completion of the railways from Johannesburg to Zeerust and to Lichtenburg has placed a large number of the company's farms in the Marico and Lichtenburg districts in direct communication with the most important industrial centres of the Transvaal, and the value of land in these districts has thereby been much enhanced. This is enabling the company to obtain a considerably better class of tenant than has hitherto been possible without the aid of railway facilities.

In the Marico district the company holds 157,016 morgen, equivalent to about 34 per cent of its total land in the Transvaal. This is stated by the Director of Agriculture to be one of the finest agricultural districts in the country; it is well wooded and watered, the rainfall being even, and, except in years of abnormal drought, plentiful, the streams issuing from the dolomite being perennial. The land yields heavy crops of wheat, barley and oats, whilst tobacco is largely cultivated, and fruit all kinds is plentiful. Now that the railway to Zeerust is in operation this district should prove one of the most important sources of food supply to Johannesburg and other industrial centres.

In the Lichtenburg district the company has a holding of 133,962 morgen, equivalent to 29 per cent. of its total land holding in the Transvaal. This is an open and elevated district, suitable for both agricultural and pastoral purposes. It is well watered and healthy, and is an exceptionally good cattle country, the highest parts being also suitable for goats and sheep. It produces summer and winter crops of creeals. On dry farms in the district boreholes which have been put down have reached water at varying depths, a record of the boreholes sunk during

the past few years showing the average depth at which water has been struck to be 120 feet, the average quantity of water obtained per borehole being 20,000 gallons per 24 hours. There has been a considerable influx of farmers to this district from the Cape and the eastern Transvaal since the opening of the railway to the town of Lichtenburg, and there is little doubt that big strides will now be made in the production of mealies, Kaffir corn and wheat in this district.

The other land holdings of the company are situate in the Rustenburg, Bloemhof, Potchefstroom, Wolmaranstaad, Pretoria, Middelburg, Lydenburg, Waterberg, Zoutpansberg and Ermelo districts of the Transvaal and in the Boshof and Vredefort districts of the Orange Free State. All the farms are suitable either for agricultural or pastoral operations.

An energetic policy has been adopted by the company to secure the permanent settlement of a good class of white tenant on its farms. A considerable sum of money has been voted for the purpose of sub-dividing the farms into blocks, for fencing the boundaries, sinking wells, and otherwise rendering the blocks suitable for immediate occupation. Very generous terms of tenancy are being offered to intending settlers, and the company is also prepared to grant financial assistance to suitable tenants to enable them to build homesteads, stock their farms, or otherwise effect improvements. The directors express themselves as confident that with the active co-operation which is now being given by the Government in the extension of railways, etc., your land represents a most valuable asset, and that it will continue to show a steady increase in value as settlement and development progresses.

Mining and Prospecting.

A small amount of prospecting work has been carried out by the company in various districts in connection with reported discoveries of diamonds, tin and other metals, but no results of any importance have so far been attained. The company's areas, however, are large and widely distributed, and as a considerable amount of general prospecting is being carried on for diamonds, tin, copper, and other minerals, the company may be expected to participate in any new discovery made. Prospecting operations on the block of base metal claims taken up by the company in the Leydsdorp district were continued during the period under review, but as the indications did not, in the opinion of the consulting engineer, justify the further expenditure required to open up the lode in depth, the claims have been abandoned and the expenditure incurred thereon has been written off.

Share Interests.

The recent reduction of capital has enabled the directors to write down the book cost of their quoted securities to below their market value. A valuation of these quoted securities taken at 31st March last shows their middle market price to be considerably above the price at which they now stand in the company's books. A re-valuation has also been made of the unquoted securities, and these have now been written down to a figure which the directors consider is well below their actual value.

The shareholdings of the company remain practically unaltered, very few realisations having been effected since the date of the last report. The directors consider that the intrinsic value of the majority of the shareholdings is considerably higher than has been reflected in the market prices ruling during the year, and that with a return of activity they will be able to realise to considerably greater advantage than has been possible during the past fifteen months.

Transvaal Interests.

One of the chief features of the year in the Transvaal has been the steady progress made in the development of properties on the far eastern extension of the Rand, in which district the company is largely interested. The producing companies in this district have been obtaining uniformily better results as depth has been attained, and other companies owning large areas have been steadily proceeding with development or with shaft sinking, the reef having been cut in the shafts on two of these properties during the past few weeks. There is every indication that this district will continue to be the centre of increasing activity as the extension of the Main Reef is further opened up, and the directors are confident that their interests in this district will show satisfactory profits.

The company has acquired a considerable debenture holding in the Vereenignig Estates, Limited, in addition to its large share interest in that company. The Vereeniging Estates has made steady progress in the development of its estates. The Victoria Falls and Transvaal Power Company is erecting a 40,000 K.W. electric power station on the property, and this should be in operation within the next few months. Its establishment is having a marked effect in attracting new industries to the neighbourhood, arrangements having recently been concluded for erecting a steel and iron works adjoining the power station. The equipment of the company's collieries is being extended to meet the increasing demands occasioned by the requirements of the power station and of the other industries which are likely to be shortly in operation there.

Rhodesian Interests.

The company holds a substantial share interest in the Rhodesia Gold Mining and Investment Company, whose principal assets are shares in the Lonely Reef, Cam and Motor, and Sabi Gold Mining Companies. The developments carried out on the properties of these companies during the past year have continued to give satisfactory results, and arrangements have now been made by the Cam and Motor Company for the erection of a plant capable of treating 15,000 tons per month. On the Lonely Reef Mine the eighth level has been reached during the past few months, the development results since carried out having proved that the reef continues to maintain its width and value as depth is attained. The ore reserves at 31st March last, were estimated by the consulting engineer at 148,738 tons of an average value of 22.86 dwts. over a stoping width of 54.5 inches. This company has now commenced the payment of dividends.



The Robinson Group

THE RANDFONTEIN ESTATES GOLD MINING COMPANY (WITWATERSRAND), LIMITED.

Capital, in £1 Shares £3,001,548

This is the parent company of all the Randfontein companies belonging to the Robinson Group.

Number of Claims held 1,414
Also Mynpachts; 1,698 acres of which are leased and 320 acres are available for future flotation.
Area of proclaimed ground ... ... 15,011 acres.
Area of unproclaimed ground ... ... 16,715 acres.
Where situated ... ... On Western Rand.
In addition to the foregoing, the company owns a large number of shares and debentures in various subsidiary companies.

DIRECTORS.
Sir Joseph Robinson, Bart., *Chairman.*
Sir Jan Langerman, M.L.A., *Vice-Chairman.*
F. S. Tudhope. N. J. Scholtz. C. A. Ferguson.
SECRETARY, J. H. Crosby.
HEAD OFFICE.
P.O. Box 2, Randfontein.
TRANSFER OFFICE, JOHANNESBURG.
Mayfair, P.O. Box 1,040, Johannesburg.
TRANSFER SECRETARY, J. H. Tiley.
LONDON TRANSFER AGENTS.
Hutton and Gibson, 30-31, St. Swithin's Lane, E.C.

The London Agents, the Transfer Secretaries, and the offices mentioned here are the same for the whole of the companies comprised in the Robinson Group.

THE ORANGE FREE STATE AND TRANSVAAL DIAMOND MINES, LIMITED.

Capital, in £1 shares £550,000

Property.—Large diamond mine on freehold farm Kaalvallei, and freehold of farm Dirksburg, 2,389 acres, in Orange Free State.

DIRECTORS.
Sir Joseph Robinson, Bart., *Chairman.*
Sir Jan Langerman, M.L.A., *Vice-Chairman.*
F. S. Tudhope. N. J. Scholtz. C. A. Ferguson.
SECRETARY, J. H. Crosby.

THE LANGLAAGTE ESTATE AND GOLD MINING COMPANY, LIMITED.*

Capital, in £1 shares £950,000
Issued Capital, in £1 shares £869,500
Capital in reserve £80,500

Property—
Claims and Mynpachts equal to ... ... 480 claims.
Number of Stamps 200
Also (*a*) freehold of farms Langlaagte and Middelfontein,
(*b*) township of Mayfair,
(*c*) A valuable property in Commissioner Street, Johannesburg, and other properties.
Where situated.—On farm Langlaagte, West of Johannesburg.

DIRECTORS.
Sir Joseph Robinson, Bart., *Chairman.*
Sir Jan Langerman, M.L.A., *Vice-Chairman.*
F. S. Tudhope. N. J. Scholtz. C. A. Ferguson.
SECRETARY, J. H. Crosby.
MANAGER, J. A. Hebbard.

*With which are now incorporated the Langlaagte Block "B," and Langlaagte Exploration and Building Companies.

THE BLOCK "B" LANGLAAGTE ESTATE GOLD MINING COMPANY, LIMITED.

In Liquidation.
Now part of Langlaagte Estate and Gold Mining Company, Limited.

THE LANGLAAGTE EXPLORATION AND BUILDING COMPANY, LIMITED.

In Liquidation.
Now part of Langlaagte Estate and Gold Mining Company, Limited.



Truck supplied to Randfontein Central by R. G. Campbell Pitt, agent for R. Hudson, the maker

THE RANDFONTEIN CENTRAL GOLD MINING COMPANY, LIMITED.

Capital £4,500,000
Shares in reserve 425,000
Number of Claims 2,303
1,000 stamps (600 in one mill at northern division, and 400 in mills of 100 each at southern division) and tube mills.
Formed in 1907 to acquire "Block A," "Mynpacht," and "West" Randfontein Companies; absorbed during 1909 the East, Ferguson, Van Hulsteyn, and Johnstone Randfontein.

DIRECTORS.

Sir Joseph Robinson, Bart., *Chairman.*
Sir Jan Langerman, M.L.A., *Vice-Chairman.*
F. S. Tudhope. N. J. Scholtz. C. A. Ferguson.
GENERAL MANAGER, C. A. Ferguson.

THE NORTH RANDFONTEIN GOLD MINING COMPANY, LIMITED.

THE PORGES RANDFONTEIN GOLD MINING COMPANY, LIMITED.

ROBINSON RANDFONTEIN GOLD MINING COMPANY, LIMITED.

THE STUBBS RANDFONTEIN GOLD MINING COMPANY, LIMITED.

THE SOUTH RANDFONTEIN GOLD MINING COMPANY, LIMITED.

Formed into Randfontein South G.M. Co., Ltd., in 1909.

RANDFONTEIN SOUTH GOLD MINING COMPANY, LIMITED.
In Liquidation.
Amalgamated with Randfontein Central G.M. Co., Ltd., in 1911.

EAST RANDFONTEIN GOLD MINING COMPANY, LIMITED.

JOHNSTONE RANDFONTEIN GOLD MINING COMPANY, LIMITED.

FERGUSON RANDFONTEIN GOLD MINING COMPANY, LIMITED.

VAN HULSTEYN RANDFONTEIN GOLD MINING COMPANY, LIMITED.

The above Gold Companies have been amalgamated and now form part of Randfontein Central.

THE RANDFONTEIN CENTRAL (NORTHERN DIVISION) PLANT.

THE GREATEST GOLD MILL IN THE WORLD—A VAST UNDERTAKING—A DESCRIPTION OF THE ENGINEERING DEPARTMENT.

The equipment of the Randfontein Central (New, or Northern, Division, is one of the outstanding engineering features of the Rand.

COMPRESSOR STATION.

The first point to be noted is the compressor station, situated at No. 3 shaft. At this centre the bulk of the compressed air is produced and transmitted by surface air mains to the various parts of the property. The equipment of the station consists of four horizontal two-stage electrically operated compressors, each having a capacity of 5,600 cubic feet of free air per minute. and driven by 800 b.h.p. synchronous motors, the speed being 108 revolutions per minute. Each cylinder is provided with a regulator which keeps the pressure within narrow limits, independent of the demand, by means of auxiliary valves which admit air from the discharge chambers back into the cylinders during part of the suction stroke.

No. 3 SHAFT.

This is one of four main shafts of the compound type, there being another main shaft, which is an incline from the surface. The headgear and hoisting equipment at each of the other main shafts is practically identical with that here, which consists of: Rock hoist, drums 10 feet by 4 feet tread, driven by two c.c. motors 350 b.h.p. each; Ward-Leonard system of control; maximum rope speed, 2,000 feet per minute. The motor generator set consists of a 2,000 volt a.c. motor, 800 h.p., driving a c.c. generator at 485 r.p.m. The brakes are operated by compressed air from the mains, the small auxiliary compressor automatically keeping the pressure above a fixed minimum. A tachograph provides a record of each trip. Immunity from accident is obtained by simple automatic devices (operated from the depth indicators) opening the circuit and applying the brakes, while in case of failure of supply the brakes automatically come into operation. The application of the brakes is in all cases gradual. Man hoist, cylinders 16½ inches by 33 inches, drums 8 feet diameter by 2 feet 3 inches wide. This will eventually be motor driven. At two of the main shafts the man hoists are built for the same size of skip as the rock hoist, but for a reduced maximum speed of 1,000 feet per minute, the drums being geared to 195 b.h.p. c.c. motors (one for each hoist). The system of control is the same as for the rock hoists, viz., Ward-Leonard. The motor generator set consists of a 2,000 volt, a.c. motor, driving a c.c. generator at 750 r.p.m. The headgear is a timber structure, 75 feet high. There are no classifying grizzlies, all rock mined going into the one bin, which has a capacity of 300 tons. The rock skips have a capacity of 3½ tons.

TRANSPORT.

The ore is transported by a 3 feet 6 inches gauge railroad from the different shafts to the reduction works, branches being laid into the compounds, workshops, etc. The rolling stock consists of steam locomotives and 40-ton hopper cars.

RECEIVING BIN.

Arriving at the reduction works, the ore is discharged into the receiving bin. This is built of reinforced concrete, and has a capacity of 1,000 tons.

CRUSHER HOUSE.

From the receiving bin the ore is taken by six conveyor belts into the crusher house, where there are six trommels, size 14 feet long by 4 feet diameter, for classifying and washing. The gritty wash water finds its way through six dewatering trommels 6 feet 6 inches long by 3 feet diameter), from which the water is led to a sump in the north-east corner of the crusher house, to be pumped into the mainlaunders in the mill, the solids eventually reaching the main fines belts into the mill by means of the cross conveyors which are installed for dealing with the fines that come through the classifying portions of the large trommels. The rock to be sorted is discharged from the large trommels on to the six lines of sorting belts, the waste being received in the bins underneath, from which it is taken to the waste dump on the east side of the mill by mechanical haulage. The pebbles for the tube mills are thrown into a bin at the end of the sorting belts, and thence taken by an automatic telpher system to storage bins outside the tube mill house. Belts are then used to convey the pebbles to the feed hoppers of the tube mills. The clean ore from the sorting belts is discharged into six jaw crushers, of cast steel, sectionalised construction, width of opening 39 inches by 17 inches. They are driven by independent motors, each 50 b.h.p. The crushed rock discharges on to cross belts underneath, which deliver to two inclined main fines belts going into the centre of the mill at the roof level.

BATTERY.

The ore is delivered by two shuttle belts into the mill bins, the storage capacity being 13,000 tons. The battery has 600 stamps, each weighing 1,650 lbs. new, arranged in units of 10 stamps, there being four king posts to each unit, the cam pulley being midway on the shaft. The units are driven in pairs (total 20 stamps) by a 100 b.h.p. motor through short countershafts fitted with belt tighteners. The duty required per 24 hours per stamp is 9¼ tons. The whole of the battery framing is of timber, supported on mass concrete foundations, there being timber pads under the mortar boxes, and a layer of bitumastic concrete under the concrete pile blocks. The mortar-box foundations are pierced throughout their length by a tunnel into which all the anchor bolts converge. Tracks in front of the mortar boxes on the battery floor and four electric travelling cranes, together with four hand crawls above the cam floor, are provided for facilitating repair work, and trap doors in the cam floor provide for distribution of light and sound as well as for communication between the cam and battery floors. Protection against fire is provided by automatic sprinklers. The pulp from the mortar boxes reaches the tailings pumps without amalgamation, the launders being lined with steel plates. The mill building is a steel structure 635 feet long by 70 feet wide, and lies about due east and west. The mill supply tanks are 60 feet diameter, and are located on the mound at the east end of the mill.

WORKSHOPS AND RUNNING SHED.

The locomotive running shed and workshops are close to the west end of the mill, the usual equipment being installed, and each trade is housed in a separate building.

TUBE MILL HOUSE.

The sand pumps are installed in deep excavations at the north end of the tube mill house, which is immediately south of the battery. There are six 10 inch Robeson-Davidson centrifugal pumps, driven by 125 h.p. motors for coarse sand, and four similar 10 inch pumps, driven by 125 h.p. motors for fine sand. The whole of the pulp as received from the battery, together with the tube mill discharge, is elevated by the coarse sand pumps to the conical classifiers (Dr. Caldecott's), the underflow of which feeds 16 tube mills, each 22 feet long by 5 feet 6 inches diameter, placed in two parallel rows of eight. All the amalgamating plates are in the centre portion of the house, between the two rows of tube mills. The tube mill discharge passes over 96 stationary copper plates (each 5 feet 3 inches by 4 feet), and thence through the coarse sand pumps into the main circuit again. Meantime the overflow from the classifiers passes direct to 128 secondary tables (each 6 feet by 5 feet 3 inches), which are situated in the middle of the house and at a higher level than the tube mill plates, and thence to the fine sand pumps which elevate it to the sand collectors. The motors for the tube mills are 100 h.p. each, and are placed on the same level as the conical classifiers, both being supported on reinforced concrete platforms, which also form the foundation for the outer sides of the tube mill building. The building is a steel structure in five spans, overall dimensions 237 feet long by 160 feet wide. The reduction officer's headquarters and clean-up room are in the south end of the building, and the whole area occupied by the amalgamating plates and clean-up apparatus is enclosed by a grille. Retorting is done in a special building near the assay office and general offices, which are situated just south of the workshops.

SAND PLANT.

This plant—which is arranged in two independent portions—consists of 36 steel tanks, 60 feet diameter. The two upper tiers are collectors, and each collector serves two treatment tanks—one directly beneath it, and another in the inner row. Transfer of the sand from the collector to the inner tank is effected by hand tramming in two-ton trucks. The tailings are deposited in the large pan south of the reduction works by two mechanical haulages, capacity of cars being 30 cubic feet each.

PRESENT POSITION AT THE RANDFONTEIN CENTRAL.

IMPROVING MONTHLY RETURNS—REVENUE AND PROFITS SHOW A MORE REASSURING TENDENCY—THE QUESTION OF ORE RESERVES.

Whereas, a few months ago, the falling revenue, diminished profit, and general unsatisfactory appearance of things at the Randfontein Central were such as to draw adverse comment of an emphatic kind, both here and in London, the returns of more recent months are so much more reassuring as to give rise to the hope that a steady period of improvement has been inaugurated on the property. The accompanying figures are

of interest as showing the record of the company during the past two and a half years.

Year ending Dec. 31.	Stamps.	Tons Milled.	Revenue per ton.	Expenses per ton.	Profit. Amount.	Profit. per ton
1910	400	1,168,641	27/ 5	18/ 2	£538,584	9/ 2
1911—						
Mar. qr. ..	607	366,834	26/11	18/ 0	162,000	8/11
June qr. ..	721	566,366	24/10	16/ 6	237,000	8/ 4
Sept. qr. ..	753	600,784	24/ 3	16/ 6	232,000	7/ 9
Dec. qr. ..	775	625,049	24/ 4	17/ 0	231,000	7/ 4
1912—						
Mar. qr. ..	798	656,641	23/ 8	17/10	172,000	5/10
April	700	199,518	23/ 3	18/ 5	58,000	5/10
May	700	210,138	24/10	18/ 0	72,800	6/10
June	700	198,547	25/ 1	17/ 9	73,250	7/ 4
July	700	194,243	26/ 3	18/ 5	76,029	7/10
August ...	700	206,037	25/ 5	17/ 7	80,992	7/10

It may be pointed out that the operations of the newly amalgamated company were first published in the Chamber of Mines Analysis for the month of March, 1911, so that the progress of the Randfontein Central, as exhibited in the tabular statement above may be taken as having been fairly under way at the beginning of the June quarter of last year. There was a steady diminution of profit during the remainder of the year, in spite of the increased crushings, and in the first quarter of 1912. The relapse culminated in an estimated profit of £53,000 in March, according to the Chamber of Mines Analysis, and there seemed no reason to expect that affairs were likely to improve under the existing circumstances. The somewhat sweeping changes in the administrative staff occurred about this time, and altogether things looked none too promising at the Central. In April, it will be seen, the profit rose to £58,000, and a large advance was made in May by the recording of a profit of £72,800, a figure which was improved upon in the succeeding months. If one compares the returns of this year with those of the corresponding period of 1911, it will be noted that the outstanding feature is the higher level of the working costs. In June, 1911, for instance, they were 16s. 6d. per ton milled, while in June, 1912, they were as high as 17s. 9d. per ton. The recovery, on the other hand, was greater in the latter month, and in this way some sort of compensation has been effected. The improvement in the recovery grade, as a matter of fact, has been somewhat marked latterly, and if it may be taken as indicating a new line of policy, its effect will be worth watching. It is difficult to say whether costs are likely to be reduced to the point around which they ranged during the greater part of last year; it is apparent that an effort is being made to reduce them, with some degree of success. A conjunction of improved recovery and more normal working costs should soon make a material difference in the monthly profit, and it is gratifying to find that under both heads there is a tendency in the right direction.

As we have said before, a great deal depends upon the ore reserve position. At the end of last year the comparative statement of progress was as follows:—

	Payable		Unpayable.	
	Tons.	Value, dwts.	Tons.	Value, dwts.
1910	5,534,303	7.54	755,024	—
1911	5,658,859	7.29	978,412	2.83

The figures show that the position was, at any rate, fairly well maintained. At the meeting of the Randfontein Central, on January 24th, 1912, the Chairman, Sir Jan Langerman, said, *inter alia*:—"At our last annual meeting I referred to the exploitation of other reefs in addition to West Reef and Randfontein Leader, traversing the property. Of these, the New and East reefs proved to be so satisfactory in value and permanent in character that they have been extensively developed during the past year. The New reef is a narrow body, and of this we have developed 263,500 tons, of which 225,000 tons are valued at 5.6 dwt. over milling width. About the East reef the manager reports that it is a reef of great width, of satisfactory value, and presents no difficulties in mining. It has been traced northwards for a distance of 3,000 feet. Since the close of the year the manager reports further on the East reef as follows:—'Development on the 2nd level continues satisfactory. To the north 12 feet have been driven, assaying 9.5 dwts. over 60 inches, while the south drive advanced 22 feet, valued at 8.2 dwts. over 60 inches. The reef intersected at 50 feet in the borehole in the footwall at No. 3 station, incline depth 600 feet, assays 5.4 dwts. over 133 inches, or 7.7 dwts. over 77 inches.'" This was a welcome announcement, and it may be expected that the development which has been actively continued on this section will prove to be an asset of no small importance.



Sir J. B. ROBINSON, Bart.

The Consolidated Mines Selection Company, Ltd.

THE CONSOLIDATED MINES SELECTION COMPANY, LIMITED.

Capital Authorised £600,000
In 1,200,000 Shares of 10s. each.
Capital Issued £552,500

DIRECTORS.

Robert James Frecheville. Max Kempner.
Robert Goering. Walter McDermott.
Frederick William Green. Carl Parcus.
Georg von Simson.

Berthold Kitzinger and Julius Sigismund Wetzlar.
Managing Directors, London.

CONSULTING ENGINEER.
W. L. Honnold.

ASSISTANT ENGINEER.
C. E. Knecht.

SECRETARY AND HEAD OFFICES.
Charles William Moore, F.C.I.S., 5, London Wall Buildings, Finsbury Circus, London, E.C.

ASSISTANT SECRETARY.
J. H. Jefferys, F.C.I.S.

JOHANNESBURG BRANCH OFFICE.
The Corner House, Johannesburg.

SUB-MANAGER.
F. R. Lynch.

SECRETARY.
A. S. Pearse.

Controlling interests are held in the following companies:—

THE NEW ERA CONSOLIDATED, LIMITED.

BRAKPAN MINES, LIMITED.

SPRINGS MINES, LIMITED.

TRANSVAAL COAL TRUST COMPANY, LIMITED.

THE OUTLOOK FOR BRAKPAN AND SPRING MINES.

Most satisfactory reports were presented at the recent annual meetings of the companies in which the Consolidated Mines Selection Company holds a controlling interest. The prosperity of the group is, of course, rooted in the excellent returns from Brakpan and the good prospects of the Springs Mines. The labour supply is now ample. Brakpan profits are being fully maintained, a dividend of 15 per cent. has already been paid and possibly more than this will be distributed in December, and the company is now out of debt. At Springs, the rate of shaft sinking, despite water and other troubles, is so good that the reef is expected to be struck before the end of the year in the north shaft, and the latest results from the Geduld augur well for reef prospects. In several particulars the late chairman's speeches brought down to date the returns recently printed from Brakpan and Springs. In the case of the former, the late chairman was able to announce that the company was now entirely out of debt, having repaid the loan contracted to cover the additional capital expenditure incurred over and above the working capital supplied and the interest earned, of which full particulars are given in the directors' report. "I quite realise that to prophesy 'before one knows' is a risky and often thankless task," he added, "but there is absolutely no reason that your directors know of to anticipate any decrease in the results now being secured. I may go even further and say that I think we may pretty confidently look forward to a somewhat increased distribution at the end of the year; but you must realise that I say this with all due reserve as to possible contingencies. These things in the event are, as always, 'on the lap of the gods.'" This is as definite and as reassuring as any chairman could make it or as any shareholder could expect. Of the Springs Mine, Mr. Hamilton was also able to speak most hopefully. Mr. Hamilton pointed out that the indications as to the value of the reef when opened up were confined, in the first instance, to the assay values obtained from the borehole cores, and in the second instance to the developments which were taking place upon the Geduld Proprietary Mines, upon the dip of which the Springs Mines ground lies. The values obtained from the borehole cores, as given in the directors' report for the year 1909, were as follow: Borehole No. 1, 28.42 dwts. over a width of 18.56 inches; borehole No. 2, 21.42 dwts. over a width of 10.81 inches. Developments at depth on Geduld are most encouraging. On No. 2 level, being driven at a vertical depth from surface of 1,825 feet, and situated 3,240 feet east of the No. 2 vertical shaft, 1,330 feet of development have been sampled out of 1,402 feet driven, and have given the satisfactory average of 9.12 dwts. over a milling width of 40 inches. "It is somewhat difficult to give reliable figures to-day," said Mr. Hamilton, "as to what the actual financial position of the company will be when the shafts are down to the reef. At the same time, you will naturally desire to get some general idea on the subject, and I can tell you it is estimated that, barring any unforeseen adverse occurrences, we should have some £50,000 left with which to start the development of the mine after the sinking costs of both shafts shall have been defrayed. The option on the second block of 165,000 shares, at the price of 40s. per share, falls due on the last day of the present year; but I have some natural diffidence—at any rate, in the present condition of the market, in anticipating that this option may be exercised." The companies of the Consolidated Mines Selection group are in a flourishing position. Indeed to the excellent showing by these Far East Rand companies is no doubt largely due the accession of confidence in South African securities lately in evidence.

BRAKPAN MINES.

GRATIFYING FIRST FRUITS—GENERAL DESCRIPTION OF THE REDUCTION WORKS—A MODERN AND MODEL PLANT.

The gratifying results now being obtained by the Brakpan Mines gives additional interest to an undertaking whose entry into the number of producing mines upon the Rand has been looked forward to with feelings of confident anticipation by those who have watched progress from the beginning of the development work. The directors and all concerned are greatly to be congratulated that so far from there being anything which the most critical could find fault with, there is being achieved a measure of success which has astonished even those who had expected much.

THE PLANT.

As one of the very newest reduction plants upon the Rand, wherein one might expect to find everything laid out upon lines which are up-to-date in every respect, and one in which, as a matter of fact, one does find at every point what is considered to be the last word in arrangement and construction, the Brakpan plant is worthy of somewhat detailed description. We are indebted to the courtesy of Mr. Honnold and his engineering staff for the plan and elevation reproduced in this issue, which show the general arrangements in a way that will enable the lay-out and course of operations to be understood very clearly, and which demonstrate at the same time that those responsible are justified in regarding the whole as quite a model plant. A scale, representing a total length of 100 feet is attached, and by means of this it will be possible to obtain some idea of the extensive area covered by the various sections from the ore bins at the shaft to the extreme ends of the sands and slimes treatment vats. It will be noted that the plant, as now erected, lies, in so far as desirable, to the left of a medium line passing through the centre of the shaft, thus leaving a corresponding space available for extension.

Shaft and Crusher Station.

Starting at the No. 2, or dip, shaft, which is divided into seven compartments, and sunk 3,700 feet to the point where the reef is intersected, we find the usual coarse and fine ore bins. As will be seen from the plan, a railway for hopper bottom trucks extends from this point to the No. 1 shaft, whence the coarse and fine ore from the bins is conveyed separately to the No. 2 shaft, the coarse being discharged into the coarse ore bin at the No. 2 shaft, and the fines being delivered into a hopper immediately above the main fines belt which conveys to the mill. From the fines bin a belt is shown leading to the same main belt. The coarse ore from both shafts is fed from the main bin on to five belts which convey it to five trommels at the south end of the crushing and sorting station. The fines passing through these trommels are carried, it will be observed, by a belt which in its turn discharges on to the main fines belt already mentioned. The rock discharged from the trommels is carried upwards along separate sorting belts directly to the crushers, and between each sorting belt, and outside the end ones will be seen waste conveyors, which deliver, towards the north end of the sorting house, on to a transverse conveyor belt which leads to a bin feeding the waste rock dump haulage. Immediately in front of the crushers is shown a belt which carries the sorted and crushed ore to the main fines belt. An exhaust flue connecting with each crusher, and with a fan attached, obviates any trouble that might arise from dust. A tube mill pebble traek is shown on the plan, and this runs below hoppers in the sorting house into which suitable material is fed by the sorters at the upper end of the sorting belts. The sorting and crushing station is roomy, well lighted, and admirably adapted in every way to the purposes of convenient and clean sorting. Provision is made for an extra trommel, sorting belt, and crusher.

The Mill.

Following now the main fines belt, which, as will be seen from the plan, goes directly to the top of the battery house, we find the ore delivered by a transverse belt, in the ordinary way, to a bin with a capacity of 6,000 tons. The number of stamps erected is 160, each having a weight of 2,004 lbs. As will be seen from an accompanying photograph, the mortar box is of the open fronted type. The stamp heads are 42 inches long and 9.5 inches in diameter, and weigh 788 lbs.; the stems weigh 696 lbs. and are 14 feet 6 inches long and 4.25 inches in diameter; the tappets are 232 lbs. in weight, and the shoes 288 lbs., with a length of 14 inches and a diameter of 9.25 inches. The total weight of heads and shoes is thus 1,076 lbs., or 53.69 per cent. of the total weight, and that of the stems and tappets 928 lbs., or 46.3 per cent. of the total falling weight, that is to say, neglecting the weight of gibs and keys. A separate motor is employed for every ten stamps. Coarse screening is used and all pulp flows directly from the boxes to two Robeson-Davidson coarse sand-pumps driven by 75 h.p. motors, whence it is elevated to the launders which distribute to the tube mill cones. All tube mill and battery launders conveying coarse sand, it may be remarked, are lined with asphalt. Room is provided for 40 additional stamps.

Tube Mill Installation.

There are seven tube mills in operation, and one more is in the course of erection, whilst provision is made for a total of ten tubes altogether. The tubes are of Allis-Chalmers type, 5 feet 6 inches in diameter and 22 feet long, fitted with Graham feeders. The pulp is dewatered by means of Caldecott diaphragm cones, the underflow which goes to the tubes carrys about 27 per cent. of moisture, which when water is added is brought up to 35 per cent. in the tube mills. The tube mills discharge, by means of launders, each to a set of six stationary amalgamating tables, 12 feet by 5 feet in width, and with a grade of 18 per cent. Amalgam traps area built at the end of each table and in the launders at the end of each set of five. The discharge pulp flows to a pit in which, again, are a couple of Robeson-Davidson pumps and the sands are thus delivered to return cones, the overflow produet from which gravitates to the cyanide plant, while the coarse underflow is returned to the tube mills for further regrinding. Immediately adjacent to the amalgamating plate house is the smelting and refinery house. Here is a reverberatory furnace capable of taking twenty No. 100 pots, and a calciner to take eight 3 feet by 2 feet 6 inches trays. There are three barrels for black sands treatment, whence the product passes to a batea amalgamating plate and 2 feet by 2 feet by 6 feet settling boxes. The amalgam from the batea is pressed in a couple of 4½ inch presses, and goes finally to a couple of Fraser and Chalmers standard retorts. The prevailing features in this section of the plant are as elsewhere, roominess and convenience of arrangement. Adjoining the amalgamating table and smelting house, in order that all handling of valuable products may be under one roof, is the Merril press annex, as shown on the plan. The gold-bearing zinc slime taken from these presses is elevated to the adjacent acid treatment vat by means of a Waygood lift.

Sands Plant.

The overflow from the tube mill return cones, as previously mentioned, goes to the cyanide plant, and, as will be seen from the plan, a set of Caldecott cones are installed between the sands collecting vats for delivering a sands product to the collectors and a slimes overflow product to the slimes launders. The cones sand discharge has a 30 per cent. moisture, but additional wash water is added with the result that a very clean sand is delivered into the 60 foot collectors. From the sands collectors the material is conveyed by belts discharging, as shown, on to a main conveyor belt, by which it is carried to a Blaisdell distributor and discharged into the sands treatment tanks. Finally the treated sands are taken in bucket conveyors by the Bleichert system of aerial haulage extending from below the treatment tanks to the extremity of a lofty cantilever and discharged on to the dump. The cantilever tower is not marked in plan, but is well shown on the accompanying elevation below. It will be remembered that Messrs. Ad. Bleichert and Co. erected this installation at Brakpan with a guarantee to dump tailings at a cost not exceeding 1.5d. per ton. The plant is doing very satisfactory work, and is well worth a visit by engineers who are interested in the important problem of the transport of ore generally.

The Slimes Plant.

The slimes overflowing the gates in the sands collecting tanks joins the overflow from the sand cones and passes to another set of cones, as shown, where the last vestiges of sand are as far as possible eliminated and sent back to the fine sands pumps and thus back to the tube mill return cones. The slimes go to settling tanks whence the pulp is transferred by centrifugal pumps to six Brown's agitators, or Pachuca tanks, 45 feet high by 15 feet in diameter. Between the slimes settling tanks and the agitators will be seen, on plan, the main pump house, in which are located the various motor driven pumps required in the cyanide treatment operations. After four hours' agitation in the Pachuca tanks with 1.6 solution to 1 of slimes, the pulp is transferred to a stock pulp tank by the same pumps by which it was delivered to the agitators, and is eventually dealt with by the Butters vacuum filter plant. This plant comprises two boxes with a total of 336 leaves, and is worked on the gravity system. As will be seen there are here the stock pulp tank, the stock solution tank, the excess pulp and the excess solution tank. The slime solution from the Butters filter is clarified through a couple of sand filters, used alternately, before being delivered to the slimes gold solution storage, whence it is pumped to the Merrill presses with the addition of zinc dust emulsion. The zinc dust, for this purpose, is fed slowly by a belt feeder into emulsifying cones, where it is agitated with weak solution by means of a jet of air. This emulsifying apparatus is located at the southern extremity of the main pump house. The sands and slimes rich solutions with zinc emulsions are pumped to the Merrill presses by three plunger pumps driven by 10 h.p. motors. The presses, it may be added, have a capacity of 1,000 tons per day.

Electrical Plant.

The electrical supply is taken from the Victoria Falls and Transvaal Power Company at two sub-stations situated on their main power line, one being situated at each end of the two main shafts, partly at 2,100 and partly at 500 volts pressure. Electric power is used throughout the plant for all purposes, the aggregate power of motors installed or pending installation being approximately 10,000 h.p. and the proportion in which power is used for different purposes is as follows:—For mine pumping, 1,500 h.p.; main hoisting engines, 4,500 h.p.; stamp battery and tube mills, 1,950 h.p.; reduction works pumping plant, 1,000 h.p.; the balance being installed for sundry surface and reduction works plant. The whole of the power supply is distributed through underground cables of the paper insulated lead covered and armoured type, of which some 28,000 feet have been laid. The cables are laid as far as possible on a ring system, whereby supply to any point can be maintained through an alternative part of the system in the event of the breakdown of any particular cable. The surface lighting is carried out by means of overhead lines, and a large amount of lighting has also been carried out underground. Of the three main hoisting engines, two are of the direct current type using Ward Leonard control supplied by a.c. to d.c. motor generators, and the third is plain three phase with rheostatic control. The capacity of each hoist is 100 tons per hour hoisted from a vertical depth of 3,800 feet. For measuring purposes the total supply is divided into six main sections, the supply to each of which is separately metered, corresponding to the broad purposes of pumping, hoisting, milling, etc. These are further subdivided into some 27 pairs of feeders for separate metering, thus giving a close check on the total and individual consumption.

Thus, briefly, we have described the reduction plant at the Brakpan mines, and in concluding our description may say that everything is working with gratifying smoothness. Credit for this great constructional achievement is largely due to Mr. J. F. Cook, consulting mechanical engineer to the Consolidated Mines Selection group, and a word of praise is also due to Messrs. Holtby and Wilmot for the sound lines upon which they laid down the power installation and distribution. It should also be mentioned that during Mr. Honnold's absence last year these gentlemen acted in consultation with Mr. C. E. Knecht, the assistant consulting engineer to the group.

The Mine.

The following notes with regard to the position at the mine will be of interest at this juncture. Mining and development operations are carried out from two shafts, distant about 4,400 feet apart, in the direction of the dip of the reef, No. 1 shaft being in the north-western portion of the area and 3,100 feet deep, and No. 2 shaft south-west of the former, 3,700 feet in depth and nearly in the centre of the claim area. The reduction plant is located, as already mentioned, in the vicinity of the No. 2 shaft. Here, also, are the machine shops, change houses, staff quarters, and offices generally. An incline way, at a low grade, the reef dipping at an average of about 7½ degrees, connects both shafts, and from this some fourteen levels are driven on both sides of the incline. Haulage between the shafts underground is effected by means of an endless rope system. Owing to the comparatively flat position of the reef the stopes opened up from the lower level in each case are worked on a modified longwall method, and since it is possible to carry rails close up to the working faces the transport of ore is effected at a much lower cost than is usual on the Rand. Stopes have been opened up on every level, and the number thus available ensures, of course, a regular and ample supply for the mill.

When it is remembered that the No. 2 shaft of the Brakpan mines is distant nearly 15,000 feet from the outcrop, it will be seen that the pessimists who talk about diminishing values in depth have a pretty considerable nut to crack in the Brakpan assays.

As a summary of the main features of the plant, the following statement may be quoted from the report of Mr. W. L. Honnold, the consulting engineer to the Consolidated Mines Selection group, which appeared in the last annual report of the Brakpan Mines, Ltd., and it may be added that in operation

the highest efficiency of each unit as a unit appears to be especially aimed at:—

"In design the plant has followed the lines mentioned in my last year's report, and may still be said to include the essential factors of advanced practice, amongst which may be mentioned: — Heavy stamps. Robeson centrifugal pumps, with double pumping. Amalgamation and gold recovery in a building apart from the battery. Amplified and thorough arrangements as to classification. Sand treatment in accordance with the practice of separate collection, belt transfer and Blaisdell distribution in the treatment tanks. Bleichert aerial haulage for the disposal of the sand residue. Pneumatic slime agitation in Pachuca tanks, followed by vacuum filtration in a Butters' plant, zinc dust precipitation and subsequent filtration in Merrill presses. Building and structural materials have been largely restricted to iron, steel and concrete, thereby insuring minimum maintenance and fire risk. In the light of recent experience it is probable that the plant as now under construction will exceed its originally estimated capacity of 60,000 tons per month, especially in so far as the battery is concerned."

STEADY PROGRESS IN PROFITS—AN ADMIRABLE RECORD—GRATIFYING DEVELOPMENT RETURNS.

The figures relating to the latest monthly returns of the Brakpan Mines mark another advance in a career of consistent progress of which the company may well be proud. The record for the seven months of the present year is, briefly, as follows: —

	Tons Milled	Revenue per ton Mil'ed.	Expenses per ton Milled.	Total Profit	Profit per ton Milled.
January	41,060	28/6	18/1	£21,373	10/5
February	42,177	28/11	17/9	23,223	11/0
March	46,782	30/6	17/7	26,119	11/2
April	48,173	30/6	17/7	46,922	12/10
May	53,650	33/0	17/7	40,317	15/0
June	55,123	32/3	17/6	40,804	14/9
July	56,180	32/1	17/3	41,077	14/8

The tonnage milled, it will be observed, has increased regularly month by month, an additional number of stamps having been put into commission. For the month of January the capacity was 110 stamps, while in July 150 out of the total of 160 were kept running. There is a prospect, therefore, of the milling capacity being still further extended to at least 60,000 tons per month. The total working profit for the half-year ended June 30th was £183,626, of which amount the sum of £112,911 was obtained during the last three months of the period. Capital expenditure during the period under review totalled £15,969. Development has been carried on as actively as possible, with gratifying results, as the accompanying statement will show: —

1912	Linear Development Feet.	On Reef. Feet.	Width. Ins.	Assay Value Dwts.
March quarter	1,916¼	1,563	42.7	8.7
June quarter	4,222	3,173¼	41.9	8.7

For the purpose of comparison, the following figures may be quoted: —

1911	Distance Sampled. Feet.	Width. Ins.	Assay Value Dwt.
March quarter	3,235	28.0	9.6
June quarter	3,325	33.72	10.26
September quarter	1,411	31.5	10.3
December quarter	1,674	42.1	10.2

The ore reserves were re-calculated at the end of last year, and on December 31st the estimated payable reserves amounted to 1,925,346 mine tons, of an average value of 6.73 dwts. At May 31st, 1911, just before milling operations commenced, the reserves were estimated at 2,035,108 mine tons, valued at 6.62 dwts. The reduced tonnage, as was explained in the consulting engineer's report, was due to the elimination of certain low grade areas which in view of the work done and information gained after the inception of milling, were considered to be unpayable.

THE ANGLO-FRENCH EXPLORATION COMPANY, LIMITED.

Capital—Ordinary Shares	£500,000
,, Preference Shares	£500,000
	£1,000,000

DIRECTORS.

F. A. Robinson (*Chairman*). Edward Wagg.
Louis Ochs. Wm. Frechevilie.
Ernest G. Mocatta. Hon. Sydney G. Holland.

MANAGING DIRECTOR IN SOUTH AFRICA.
W. Dalrymple.

MANAGING DIRECTOR IN ENGLAND.
W. Henderson Clark.

CONSULTING ENGINEER IN SOUTH AFRICA.
E. J. Way, M.I.C.E., M.I.M.E., etc.

ENGINEER IN LONDON.
John A. Dennison, M.I.M.M., A.M.I.Mech.E., etc.

MANAGER IN JOHANNESBURG.
G. R. Airth, F.S.A.A.

SECRETARIES.
S. Douglas Thomson, C.A. (London). E. H. Read. (Johannesburg).

OFFICE ADDRESSES.
London.—208/224 Salisbury House, Finsbury Circus, E.C.
Johannesburg.—Third Floor, National Bank Buildings, Simmonds Street.
Sydney.—National Mutual Chambers, corner of Bond and Pitt Streets.
Toronto.—534, Confederation Life Chambers.

THE ANGLO-FRENCH MATABELELAND COMPANY, LIMITED.

Capital	£110,000
Issued Capital	£93,040
Reserve	£16,960

Properties.—In Matabeleland, 61 farms and an unlocated land grant (6,360 acres) comprising 390,668 acres and 200 mining claims.

Investments.—17,593 Penhalonga Mines, Limited, shares. £10,000 Rhodesian Railway debentures.

DIRECTORS.

Ernest G. Mocatta (*Chairman*). F. A. Robinson.
Louis Ochs. Edward Wagg.
A. Little.

MANAGER IN RHODESIA.
R. H. Urmson.

LONDON SECRETARY AND OFFICES.
T. H. Brown, 208/224, Salisbury House, Finsbury Circus, E.C.

AFRIKANDER PROPRIETARY GOLD MINES, LIMITED.

Capital, in £1 shares £280,000

Property.—292 claims on farms Rietkuil and Wolverand, district Klerksdorp; 20 machine stands on farm Rietkuil; water-right; Wolverand mynpacht, equal to 364.3 claims; and freehold of a portion of farm Kaffirskraal, district Potchefstroom, in extent 18 morgen 40 square roods.

It is estimated that 404 claims are reef bearing.

DIRECTORS.

Dr. J. Schlesinger (*Chairman*)	*alternate*	D. Wightman.
Wm. Dalrymple		
G. W. Higgins	,,	C. P. Marais.
F. D. Chaplin.	,,	F. Leslie Brown.
G. R. Airth	,,	E. H. Read.
Major H. A. Rogers.		
Robert Niven.		

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CONSULTING ENGINEER.
E. J. Way, M.I.C.E., M.I.M.E., etc.

LONDON AGENTS.
The Anglo-French Exploration Company, Limited.

NEW BOKSBURG GOLD MINES, LIMITED.

Capital Authorised	£740,000
Capital Registered	£565,000
Capital Issued	£540,000
Reserve	£25,000
Number of Claims	956

Situated on the East Rand.

DIRECTORS.

Wm. Dalrymple (*Acting-Chairman*).		
G. W. Higgins	*alternate*	J. E. Grieveson.
G. R. Airth	,,	E. H. Read.
Wm. Pott	,,	J. Davidson.
C. R. Pinder.		

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E. M. Clarke.	F. W. Crookshank.
Wm. Henderson Clark.	J. K. Edward.

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E. J. Way, M.I.C.E., M.I.M.E., etc.

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LONDON AGENTS.
The Anglo-French Exploration Company, Limited.

KLEINFONTEIN ESTATES AND TOWNSHIP, LIMITED.

Capital, in £1 shares	£100,000
Capital issued	£85,000
Reserve	£15,000

Property.—Portion of freehold farm Kleinfontein, No. 9, district Boksburg, in extent 2,683 morgen 120 square roods, less 101 morgen 154 square roods vested in Benoni Municipality ofr Townlands; three dams of a total storage capacity of 993,000,000 gallons of water; and 1,083 stands in Benoni Township not disposed of as at 30th June 1912.

DIRECTORS.

Wm. Dalrymple (*Acting-Chairman*).		
G. W. Higgins	*alternate*	W. J. Gau.
G. R. Airth	,,	E. H. Read.
A. G. Gill	,,	W. H. B. Frank.
C. R. Pinder	,,	C. P. Marais.

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LONDON SECRETARY AND OFFICES.
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LONDON AGENTS.
The Anglo-French Exploration Company, Limited.

BENONI CONSOLIDATED GOLD MINES, LIMITED.

Capital, in £1 shares	£400,000
Issued Capital...	£394,249
Reserve	£5,751
Number of Claims	355,587

Situated on the farm Benoni in Boksburg district, and 4 stands in Benoni Township.

DIRECTORS.

Wm. Dalrymple (*Acting-Chairman*)	*alternate*	E. H. Read.
H. O'K. Webber	,,	H. P. Rogers.
S. C. Black	,,	W. T. Graham.
G. W. Higgins	,,	W. J. Gau.
G. R. Airth.		
C. R. Pinder	,,	C. P. Marais.

LONDON COMMITTEE.
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F. A. Robinson.
MANAGER: E. H. Bulman.

SECRETARY AND OFFICES.
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LONDON SECRETARY AND OFFICES.
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LONDON AGENTS.
The Anglo-French Exploration Company, Limited.

ANGLO-FRENCH EXPLORATION COMPANY, LIMITED. NEW KLEINFONTEIN COMPANY, LIMITED.

(Incorporated in the Transvaal).

Capital, in £1 shares £970,000

Number of Claims, 348; situated on the Farms Kleinfontein and Benoni, in the Boksburg District. Number of stamps, 220 and 4 tube mills.

DIRECTORS.

W. Dalrymple (*Chairman*)	*alternate*	E. H. Read.
G. R. Airth.		
Wm. Ross	,,	A. Aiken.
J. H. Ryan	,,	B. Southwell.
G. W. Higgins	,,	W. J. Gau.
A. G. Gill	,,	W. H. B. Frank.
C. R. Pinder	,,	C. P. Marais.

CONSULTING ENGINEER.
Edward J. Way, M.Inst.C.E.

GENERAL MANAGER.
R. M. Torin.

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LONDON COMMITTEE.

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S. H. Farrar	J. L. Bergson
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HEAD OFFICE.
National Bank Buildings, Johannesburg. P.O. Box 1364.

APEX MINES, LIMITED.

(Incorporated in the Transvaal.)

Capital, in £1 shares £300,000

Property.—Freehold of the farm Rietfontein, No. 11, in extent 3,577 morgen, which is about to be proclaimed, and on which the company has received the grant of a mynpacht, equal to ... ... 1,028 claims
And as Discoverers they have been allotted ... 87 claims

Total ... ... 1,115 claims

Coal Mine.—The estimated life of the coal mine is twenty-eight years on the basis of an output of 20,000 tons per month.

DIRECTORS.

W. Dalrymple.		
C. R. Pinder	*alternate*	C. P. Marais.
G. W. Higgins	,,	W. J. Gau.
J. H. Ryan	,,	B. Southwell.
G. C. Fitzpatrick	,,	H. W. Anderson.
G. R. Airth	,,	E. H. Read.

CONSULTING ENGINEER.
Edward J. Way, M.Inst.C.E.

MANAGERS AT MINE.
Coal Section: J. R. Thom. Gold Section: E. H. Bulman.

BUSINESS MANAGER.
Gordon Sandilands.

SECRETARY.
H. P. Webber.

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Wm. Henderson Clark	A. O. Julius.
S. H. Farrar	E. Wagg.
E. M. Clarke	

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LONDON SECRETARY.
John H. Clark.

HEAD OFFICE.
National Bank Buildings, Simmonds Street, Johannesburg.
P.O. Box 1083.

THE ROOIBERG MINERALS DEVELOPMENT COMPANY, LIMITED.

(Incorporated in the Transvaal.)

Capital (180,000 full paid-up shares of £1 each) ... £180,000

Property.—(a) Freehold of the southern half of Olievenbosch No. 939, district Rustenburg, in extent 971 morgen 141 square roods; (b) freehold of 2,887 morgen of Hartebeestfontein No. 310, district Rustenburg; (c) mineral rights of the farm Haartebeestfontein No. 310. The above farms are situated about forty miles due west of Warmbaths Station. Ten stamps.

DIRECTORS.

W. Dalrymple,	*alternate*	G. R. Airth.
W. McCallum	,,	F. E. Nellist.
G. W. Higgins	,,	W. J. Gau.
E. Friedlander	,,	F. H. Elkan.
John Roy.		

CONSULTING ENGINEER.
E. J. Way, M.Inst.C.E.

MANAGER.
E. R. Shoch.

SECRETARY.
H. P. Webber.

LONDON COMMITTEE.
T. F. Dalglish.
S. H. Farrar *alternate* E. M. Clarke.
Wm. Henderson Clark.
M. Lambert.

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LONDON SECRETARY.
Th. Brown.

HEAD OFFICE.
National Bank Buildings, Simmonds Street, Johannesburg.
P.O. Box 1083.

ANGLO-FRENCH (TRANSVAAL) NAVIGATION COAL ESTATES, LIMITED.

(Incorporated in the Transvaal.)

Registered Capital £230,000

Divided into 110,000 ordinary shares of £1 each, and 120,000 preference shares of £1 each, all of which are fully paid and issued.

DIRECTORS.

W. Dalrymple (*Chairman*).		
G. W. Higgins	*alternate*	W. J. Gau.
B. Hansford	,,	R. T. Mathison.
A. Little	,,	G. Sandilands.
G. R. Airth	,,	E. H. Read.
C. R. Pinder	,,	C. P. Marais.

CONSULTING ENGINEER.
Edward J. Way, M.Inst.C.E.

GENERAL MANAGER.
J. R. Thom.

MANAGER AT MINE.
L. M. Shearer.

SECRETARY.
H. P. Webber.

LONDON COMMITTEE.

Sidney H. Farrar	E. M. Clarke.
Wm. Henderson Clark.	Edward Wagg.

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LONDON SECRETARY.
John H. Clark.

HEAD OFFICE.
National Bank Buildings, Simmonds Street, Johannesburg.
P.O. Box 1083.

The property consists of freehold farms, part of the farm Elandsfontein No. 512, Middelburg District, in extent 2,391 morgen 31 square roods; certain portion of farm Zaaihoek No. 53, Middelburg District, known as Diep Kloof, in extent 336 morgen 465 square roods; mineral rights, Bosmanspruit No. 259, Middelburg District, in extent 3,330 morgen 118 square roods; leasehold of mineral rights, north-eastern portion of farm Blaauwkrantz No. 171, Middelburg District, in extent 1,000 morgen; leasehold of coal rights, south-western portion of farm Blaauwkranz No. 171, Middelburg District, in extent 1,000 morgen 2 square roods.

RAND KLIP, LIMITED.

Registered Capital	£475,000
Issued	£432,336
Reserve	£42,664

DIRECTORS.

W. Dalrymple (*Chairman*).		
G. W. Higgins	*alternate*	W. J. Gau.
G. R. Airth	,,	E. H. Read.
H. Eckstein	,,	M. Honnet.
A. G. Gill	,,	W. H. B. Frank.
J. A. Cohen.		
C. R. Pinder	,,	C. P. Marais.

CONSULTING ENGINEER.
Edward J. Way, M.Inst.C.E.

SECRETARY.
H. P. Webber.

LONDON COMMITTEE.

S. H. Farrar	E. M. Clarke.
Wm. Henderson Clark.	F. A. Robinson.
L. Ehrlich.	

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LONDON SECRETARY.
John H. Clark.

HEAD OFFICE.
National Bank Buildings, Simmonds Street, Johannesburg.
P.O. Box 1083.

It owns the freehold of the unproclaimed farm Klipfontein, in the Boksburg district, on the eastern extension of the Rand, in extent 3,451 morgen.

ANGLO-FRENCH LAND COMPANY OF THE TRANSVAAL.

(Incorporated in the Transvaal.)

Capital	£100,000
Issued	£80,000
Reserve	£20,000

DIRECTORS.

W. Dalrymple (*Chairman*).		
G. R. Airth	*alternate*	E. H. Read.
G. W. Higgins	,,	C. P. Marais.
S. C. Black.		
A. G. Gill	,,	W. H. B. Frank.
C. R. Pinder	,,	W. J. Gau.

SECRETARY.
H. P. Webber.

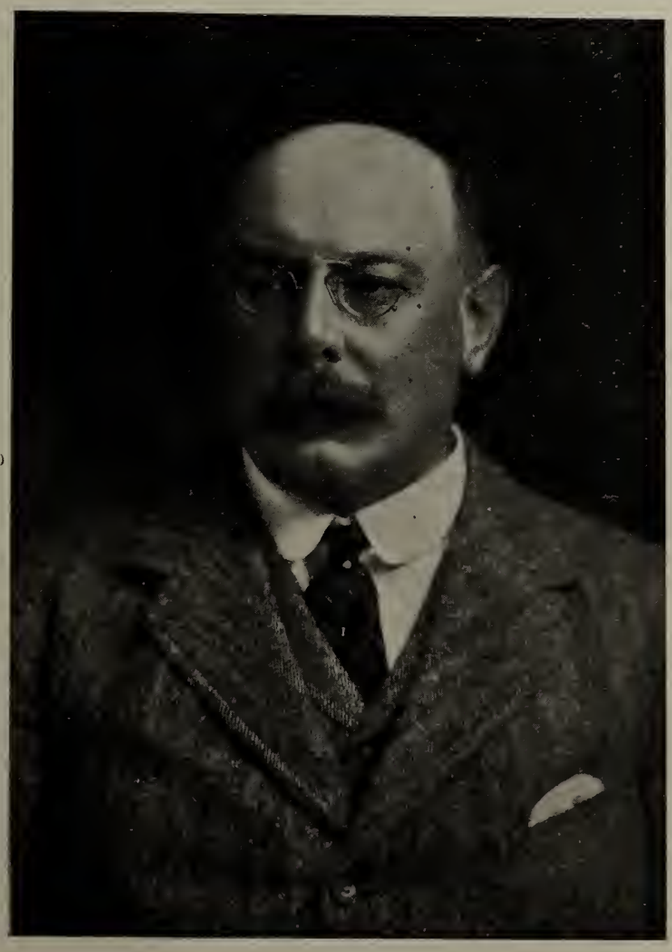
LONDON COMMITTEE.

E. M. Clarke	W. Henderson Clark.
S. H. Farrar	E. Wagg.

LONDON SECRETARY.
John H. Clark.

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HEAD OFFICE.
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P.O Box 1364, Johannesburg.



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THE NORTHERN TRANSVAAL LAND COMPANY, LIMITED

Capital Authorised, £50,000, in 200,000 shares of 5s. each £50,000
Capital Issued, £44,576, in 178,304 shares of 5s. each... £44,576
21,696 shares in reserve.

Property consists of 58 farms—274,384 acres freehold, owning all mineral and surface rights, and three farms 16,856 acres all mineral rights.

DIRECTORS.
Edward W. Cox-Moore, *Chairman.*
Chas. M. Shepherd. Francis Youle.

NOTES ON GEOLOGICAL FORMATION.

Archaean System.—This system is more prolific of mineral occurrences than any other. The largest proportion of the company's farms are on this system, and consist of 173,715 acres.

Waterberg System.—Copper and tin have been discovered on this system. The company's holding is 63,391 acres.

Amygdaloidal Diabase.—No mineral deposits of importance have yet been discovered on this formation. The company's holding is 38,661 acres.

Pretoria Series.—Gold, silver and base metals have been located on this series. The company's holding is 11,469 acres.

Witwatersrand Beds.—The company own 4,011 acres, partly on this series and partly on the Amygdaloidal Diabase formation.

The Northern Transvaal Lands has ample funds for general purposes, but for the turning of some of the mineral assets to account it was thought advisable to form a subsidiary. A company has been formed called the Northern Minerals (Transvaal), Limited, for the purpose of exploring and developing five out of the 66 farms owned by the Northern Transvaal Lands, Co., Ltd. For the purchase outright of these five farms the company received £5,000 in cash and a substantial holding in ordinary and deferred shares in the Minerals Company. Several agreements have recently been entered into for exploring and developing several other farms belonging to the Northern Transvaal Lands Company.

Amongst the latter company's big holdings it is possessed of 57,788 acres in the Selati and Spelonken Districts, a country rich in minerals—corundrum, gold, mica and tin exist. The advent of the railway must necessarily help in the exploring and opening up of these properties. Apart from the mineral standpoint, it is a splendid agricultural country. The following is taken from page 174 of the Government Geological Survey Memoir, No. 6. The Geology of the Murchison Range and District by A. L. Hall, B.A., F.G.S:—

"The opening of the Selati Railway and its extension from Gravelotte westwards through the heart of the "mist-belt," along the lower slopes of the Drakensberg will undoubtedly prove of far-reaching consequences to local agriculture. It is only necessary to mention the fact that the whole of the remarkably fertile stretch of country round Tzaneen, the entire district of Agatha and Mashutisberg, together with a by-no-means inconsiderable portion of the woodbush country, will fall within the beneficial sphere of the new railway, to show what an impetus will be given to agricultural development. Permanent and abundant water is everywhere close at hand, the soil is of exceptionally fine quality, and the climate healthy; a good proportion of this highly-favoured area, moreover, is Government ground. The above country, more or less co-extensive with the "mist-belt" region, together with its southerly extension along the foot of the Drakensberg, is the finest stretch of agricultural ground which has come under the writer's notice during the course of some nine years' travelling through various parts of the Transvaal Province."

The formation of a subsidiary company to undertake a vigorous programme of exploration on the five farms taken over by the Minerals Company with a view to the formation of other companies to work adequately the minerals after a certain amount of exploratory work is good. In this way the Northern Transvaal Lands Company has real possibilities of developing into a substantial holding company, interested in active mining operations by subsidiaries.

As regards the land, the surface rights are being made use of. Farms have been let in some cases with options at prices showing large profits on book values, and the company is being carried on at a profit.

Undoubtedly the value of land is on the up grade, and our belief is that this company will be one of the first to participate in the benefits accruing to the sound land companies in the near future.

NORTHERN MINERALS (TRANSVAAL), LIMITED

Share Capital £45,000
Divided into 160,000 Ordinary Shares of 5s. each ... £40,000
And 100,000 Deferred Shares of 1s. each £5,000

DIRECTORS.
Edward W. Cox-Moore, *Chairman.*
Julius Pam. George Parker.

In view of the recent favourable developments in the Northern Transvaal and the Bloemhof District, this company has been formed to acquire from the Northern Transvaal Lands Company, Limited, the undermentioned farms (including both mineral and surface rights), comprising an area, more or less, of 33,637 acres in the Bloemhof, Zoutpansberg and Waterberg Districts of the Transvaal, for the purpose of prospecting and developing their mineral and other resources, and of forming a subsidiary company or companies to deal with the same.

Bloemhoef District.—Commissie Rust (Official No. 93) 8,040 acres (diamondiferous).

Zoutpansberg District.—Voorburg (Official No. 1,453) 9,798 acres (coal and copper).

Waterberg District.—Kranskloof (Official No. 608), 7,294 acres (tin); Vaalpenskraal (Official No. 587), 4,143 acres (tin); Zondagsfontein (Official No. 1,659), 4,362 acres (copper).

Commissie Rust.—The company is at present opening up and developing this farm, and diamonds of exceptional quality are being recovered, the stones being of an average value of £6 per carat.

Kranskloof.—Arrangements are being made to prospect and open up this property. It is believed on best authority that the tin zone will be located on the Eastern portion of this farm.

Voorburg.—This is a very large farm, containing coal and copper deposits, and since the company was formed developments by the Messina Coal and Metals Company show that the seams dip into this property. The coal outcrops in a spruit on Voorburg. It is intended very shortly to put down a shaft to prove a big area ready for develoment on arrival of the railway, which is expected to reach Voorburg about next March. Latest official information is that the line will actually pass through the eastern portion of the farm. A number of properties in this district are being opened up for copper in anticipation of the advent of the railway necessitating a demand for coal. This, with railway requirements, will create a fair local demand for the coal.

Vaalpenskraal.—An agreement has been entered into with a prospector for opening up this property on advantageous terms, and tin ore of a promising nature has been located by him.

The Northern Minerals Company has been floated on sound lines. It means this, that when the reserve shares have been issued even at par there will be £30,000 available out of a total capital of £45,000, and it is more than probable owing to the company having been issued on such a satisfactory basis that the balance of shares should command a premium.

READ'S DRIFT LAND COMPANY, LIMITED

Authorised Capital £75,000
Issued Capital £65,000

DIRECTORS.
H. S. N. Killik, *Chairman.*
Edward W. Cox-Moore.
Harry Sopper.
Townsend Shaw.
F. M. Still.

Properties consist of 205,367 acres of land situate at and below the confluence of the Orange and Vaal Rivers, district of Hay and Herbert, Griqualand West, Cape Province, with a river frontage of 60 miles.

A large block of land has been put under irrigation, and agricultural operations are being carried on viz., cattle ranching, lucerne growing and sheep farming, and we notice from a recent speech of the chairman at the annual meeting held in London that they are making arrangements for the cultivation of cereals on a portion of the company's property on the principle familiar to those acquainted with the farming conditions in the Argentine Republic, where the tenant pays a proportion of the crop as rent. It is satisfactory to the shareholders to know that from the advices of a competent valuer the property is worth more than its book value. We can quite believe this, as the property is most favourably situated, and the farms stand at a very low value in the balance sheet. We note also that the Government have recently acquired a large area of land adjoining. This should certainly facilitate the building of the projected railway in the near future, which must improve the value of the company's land considerably.

This company is alive to the fact that South Africa is on the eve of big agricultural developments, and is preparing to take its full share in the opening up of the country.

1912.

PRICE 3/6

THE SOUTH AFRICAN Mining Journal

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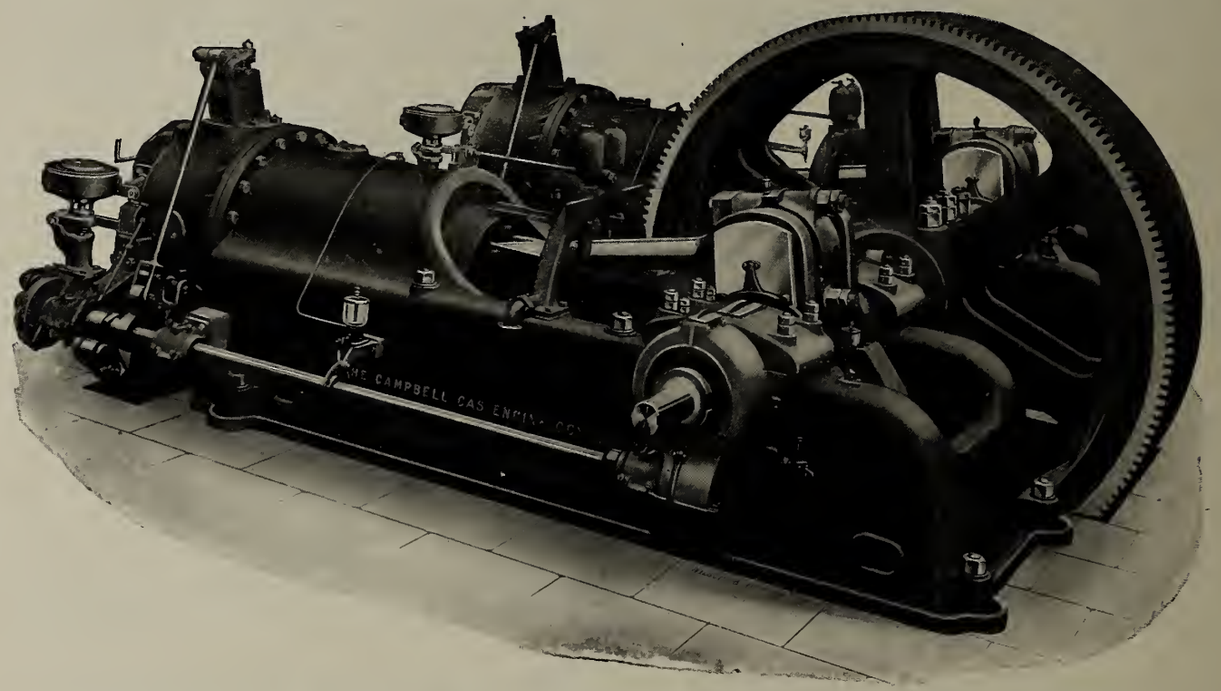


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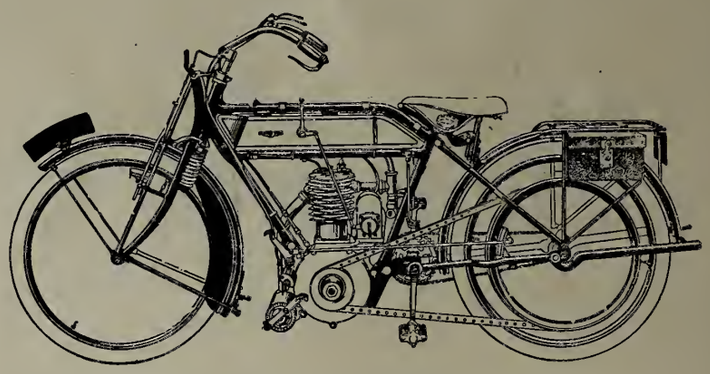
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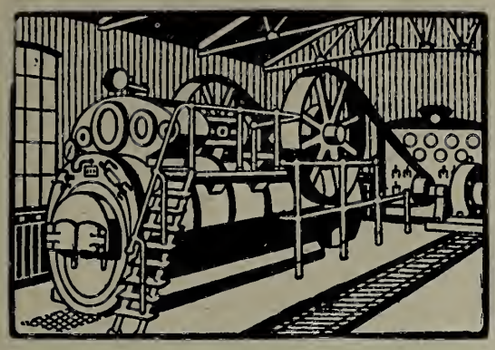
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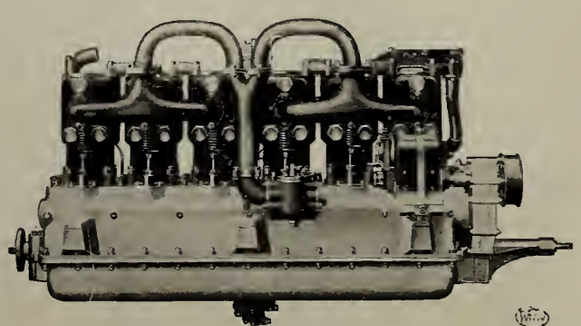
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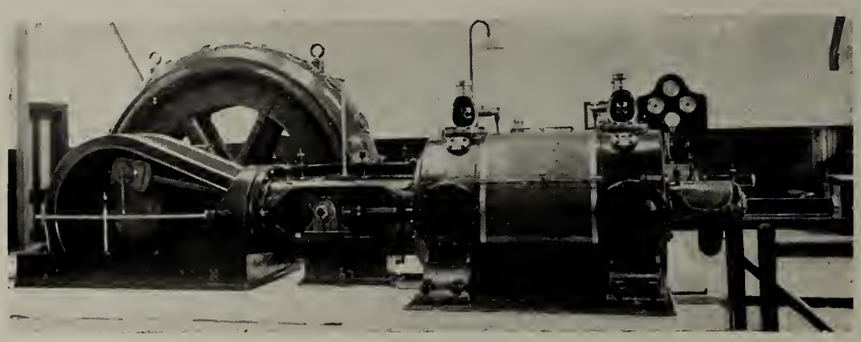
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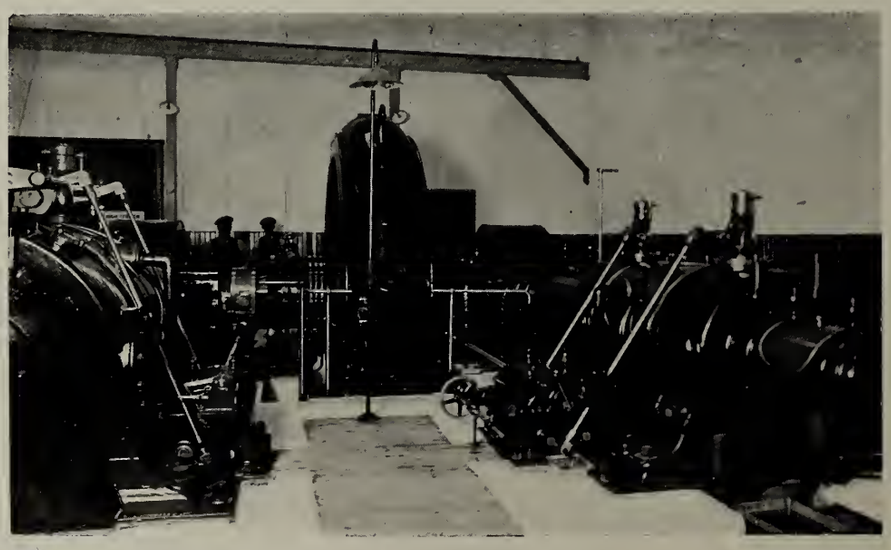
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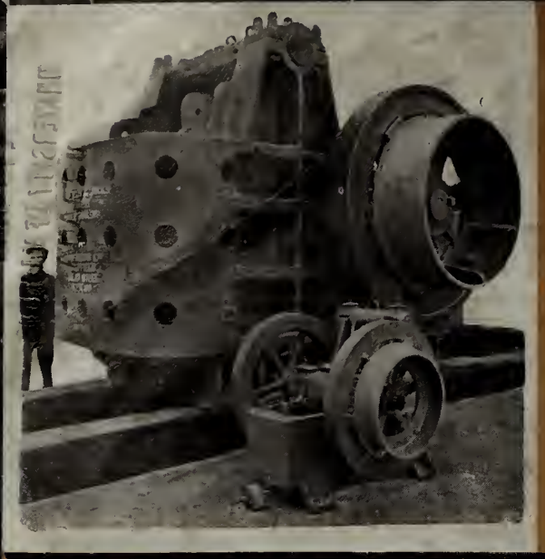
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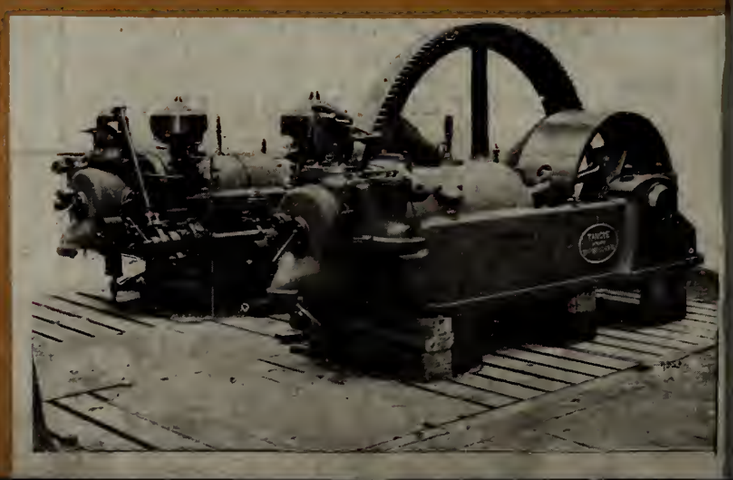
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